Improved direct mapping of acoustic waveguides to lattice models

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Abstract

The propagation of acoustic waves in waveguides provides an effective testbed for studying topological insulators and their properties. Recent studies have demonstrated how waveguides can be used to model the one-dimensional (1D) Su-Schrieffer-Heeger (SSH) model. In these works, it has been shown that an acoustic waveguide can be directly mapped to a 1D SSH, which supports the presence of edge modes through chiral symmetry and where the geometry of the waveguide plays the role of inter and intra-site hopping's. This 1D modelling approximates the 3D problem and it ignores near field effects at each change of cross-section of the waveguide. Here, by using an expression for the discontinuities at the cross-sections for the pressure and flux, which contains a so-called correction length, this improved discrete SSH model achieves a better alignment between the eigenfrequencies of the discrete SSH and those obtained from finite-element simulations. Furthermore, with the use of the improved discrete equations, it is possible to show that some robustness of the edge mode can be maintained.

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