Anti-plane surface waves in media with surface structures and surface interfaces. Discrete and continuum models

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We present a comparison of the dispersion relations derived for anti-plane surface waves using the two distinct approaches of the surface elasticity vis-a-vis the lattice dynamics. We consider an elastic half-space with surface stresses described within the Gurtin-Murdoch model, and present a formulation of its discrete counterpart that is a square lattice half-plane with surface row of particles having mass and elastic bonds different from the ones in the bulk. As both models possess anti-plane surface waves we discuss similarities between continuum and discrete solutions. In particular, in the context of the behaviour of phase velocity, we discuss the possible characterization of the surface shear modulus through the parameters involved in lattice formulation. Within the lattice dynamics formulation, we present an exact solution for anti-plane surface waves in a square lattice strip with a surface row of material particles of two types separated by a linear interface. The considered problem is a discrete analogue of an elastic half-space with surface stresses modelled through the simplified Gurtin-Murdoch model, where we have an interfacial line separating areas with different surface elastic properties. The attention is paid to the transmittance and the reflectance of a wave across the interface. The presented results shed a light on the influence on surface waves of surface inhomogeneity in surface elastic properties such as grain and subgrain boundaries. Some other problems of wave propagation are discussed.

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