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Localized Mode and Propagating Quasi-mode in 2D Acoustic Inhomogeneous Media

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Abstract:

In recent years, there has been growing interest in classical wave propagation and scattering in composite media1-3. For periodic media, it is concerned with the band gap in the dispersion relations of photonic4 or phononic crystals8,9. For the random media, if the wavelength is comparable to the scale of random inhomogeneities, the character of the wave propagation is generally expected to change drastically due to the strong multiple scattering2,10-12.
A significant effort has been devoted to the study of phononic crystals8, 9, by analogy with photonic crystals4 and electrons wave in a periodic potential field6,7. Symmetry breaking including defect will lead to wave localization5-7. In present letter9, we investigated effects of defect location on the defect frequency and the localization of phonons in two novel kinds of model, created by moving the location of the native cylinder and inserting an ad-cylinder in the central cellular respectively. The results show that the defect frequency in Model 1 is only related to the distance, while in Model 2, is related not only to the distance, but also to the moving direction.
It is conventional wisdom that an isotropic, homogeneous, elastic solid has one longitudinal and two transverse modes, and a fluid has only one longitudinal acoustic mode. In 3D colloidal suspensions, both experiment and theoretical calculations show that in the intermediate frequency regime, there existed two distinct longitudinal modes with finite lifetimes10. In this paper11, using the generalized coherent-potential-approximation approach, we present the dispersion relation of the 2D dispersed random media. In the intermediate-frequency regime, two acoustic modes are found in colloidal suspensions including cylindrical plastic rod in water background, which is contrary to the conventional view that only diffusive transport exists in the strong scattering regime. Their characteristics are shown to vary with the concentration of the solid cylinders. The scattering cross section offers a good explanation for the two modes and the observed frequency gaps in the excitation spectra.

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