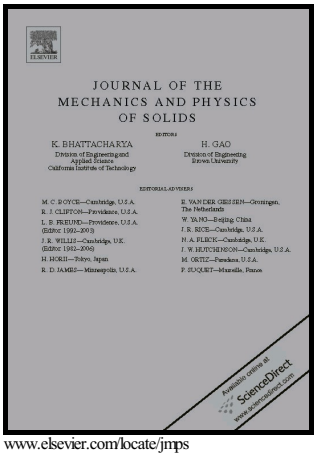

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Recovery of correlation function of internal random rough surfaces from diffusely scattered elastic waves

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Abstract

We propose an ultrasonic methodology to reconstruct the height correlation function of remotely inaccessible random rough surfaces in solids. The inverse method is based on the Kirchhoff approximation(KA), and it requires measuring the angular distribution of diffuse scattering intensities by sending in a narrow band incident pulse. Near field scattering effects are also included by considering the Fresnel assumption. The proposed approach is successfully verified by simulating the scattering from multiple realizations of rough surfaces whose correlation function is known, calculating the mean scattering intensities from these received signals, and then deploying the inverse method on these to reconstruct the original correlation function. Very good agreement between the reconstructed correlation function and the original is found, for a wide range of roughness parameters. In addition, the effect of reducing the number of realizations to approximate the mean intensity are investigated, providing confidence bounds for the experiment. An experiment on a corrugated rough surface is performed with a limited number of scans using a phased array, which further validates the proposed inversion algorithm.

Keywords: Random rough surface, Inverse problem, Diffuse elastic waves, Correlation function

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