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Diffuse ultrasonic backscatter at oblique incidence for heterogeneous solids

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Diffuse ultrasonic backscatter techniques are useful for probing heterogeneous materials. They can be used to extract microstructural parameters and to detect flaws which cannot be detected by conventional ultrasonic techniques. Such experiments, usually done using a modified pulse-echo technique, utilize the spatial variance of the signals as a primary measure of microstructure. Quantitative ultrasonic scattering models include components of both transducer beams as well as microstructural scattering information. Of particular interest for interpretation of many experiments is the propagation through a liquid-solid interface at normal and oblique incidence. Here, the Wigner distribution of the beam pattern of an ultrasonic transducer through a liquid-solid interface is used in conjunction with the stochastic wave equation to model this scattering problem within a single scattering formulism. The Wigner distribution represents a distribution in space and time of the spectral energy density as a function of wave vector and frequency. A Gaussian beam is used to model the transducer beam pattern. The scattered response in the time domain is then compared with experimental results for materials of common interest. These results are anticipated to impact ultrasonic nondestructive evaluation and characterization of heterogeneous media.