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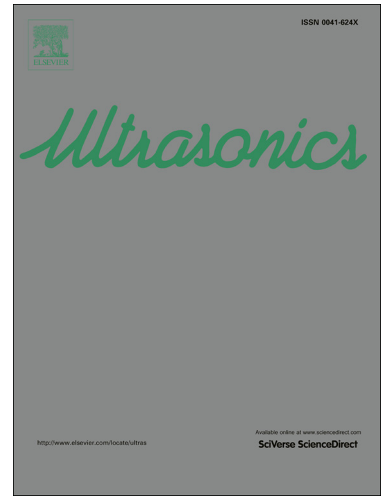

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Measurements of ultrasound velocity and attenuation in numerical anisotropic porous media compared to Biot's and multiple scattering models

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Abstract

This article quantitatively investigates ultrasound propagation in numerical anisotropic porous media with finite-difference simulations in 3D. The propagation media consist of clusters of ellipsoidal scatterers randomly distributed in water, mimicking the anisotropic structure of cancellous bone. Velocities and attenuation coefficients of the ensemble-averaged transmitted wave (also known as the coherent wave) are measured in various configurations. As in real cancellous bone, one or two longitudinal modes emerge, depending on the micro-structure. The results are confronted with two standard theoretical approaches: Biot's theory, usually invoked in porous media, and the Independent Scattering Approximation (ISA), a classical first-order approach of multiple scattering theory. On the one hand, when only one longitudinal wave is observed, it is found that at porosities higher than 90% the ISA successfully predicts the attenuation coefficient (unlike Biot's theory), as well as the existence of negative dispersion. On the other hand, the ISA is not well suited to study two-wave propagation, unlike Biot's model, at least as far as wave speeds are concerned. No free fitting parameters were used for