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Numerical modeling of collinear mixing of compressional and shear waves in nonlinear elastic media using the iterative nonlinear contrast source method

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In nondestructive testing, nonlinear wave mixing could be used to obtain the nonlinearity parameters of an elastic medium and thereby get information about its state, e.g. aging and fatigue. To better understand the mixing mechanisms and optimize the design of measurement setups, a physics-oriented tool for the simulation of nonlinear elastic wave propagation would be valuable. In this presentation, we extend the iterative nonlinear contrast source method (INCS) to study the nonlinear mixing of two plane, collinear bulk waves (one compressional, one shear) in a homogeneous, isotropic, elastic medium with two independent coefficients of nonlinearity (β_L, β_T). The method successfully captured the resonant wave generated due to the mixing (one-way and two-way) of primary waves of different frequencies. The obtained results for the resonant wave were in good agreement with the results reported in the literature. In addition, the contrast source allowed the propagating and evanescent components of the scattered wave field to be studied in the wavenumber-frequency domain, which provides physical insight in the mixing process and explains the propagation direction of the scattered wave. Thus, the INCS method seems to be a useful tool to investigate and predict wave mixing in nonlinear elastic media.

(199 words)