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Elastic wave propagation in the presence of linear and nonlinear dispersive mechanisms ROMIK KHAJEHTOURIAN, MAHMOUD HUSSEIN, Department of Aerospace Engineering Sciences, University of Colorado Boulder, Boulder, Colorado 80309 — The introduction of nonlinear and dispersive effects alters the dispersion of elastic waves in a solid medium. In this work, we derive an exact dispersion relation for longitudinal elastic wave propagation in a one-dimensional homogeneous thin rod in the presence of both linear and nonlinear dispersive mechanisms. Our amplitude- and radius-dependent exact dispersion relation contains the effects of finite strain, specifically Green-Lagrange strain, as well as lateral inertia. In general, the nonlinearity tends to steepen the waveform since large-amplitude waves are able to catch up with slower low-amplitude waves while the dispersion widens the waveform since large-wavelength waves cannot catch up with faster small-wavelength waves. The dispersion relation presented in this work provides information on both these mechanisms which may be used to elucidate the interplay between the waveform narrowing and widening effects due to nonlinearity and dispersion, respectively. A discussion is provided on the implications of the present analysis on elucidating the properties of shock and solitary waves.

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