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Quadratically nonlinear wave interactions in fiber-reinforced materials with dissipative effects

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This paper investigates the interaction of weakly nonlinear waves in fiber-reinforced materials [1]. The constitutive relations consist of hyperelastic, polyconvex models incorporating a description that facilitates the modeling of mechanical dissipation. Models of this type can be used, for example, to describe membrane-shell structures made of textile materials or elastomeric bearings [2]
We analyze equations characterizing plane wave motion. The study focuses on quadratically nonlinear effects for shear plane waves. Using the method of weakly nonlinear asymptotics, the coupled evolution equations for the amplitudes of different pairs of waves are derived. It turns out that, in contrast to the isotropic case, quadratic nonlinear coupling is possible between shear waves in anisotropic solids [3,4]. We illustrate some properties by presenting numerical solutions for the evolution equations.

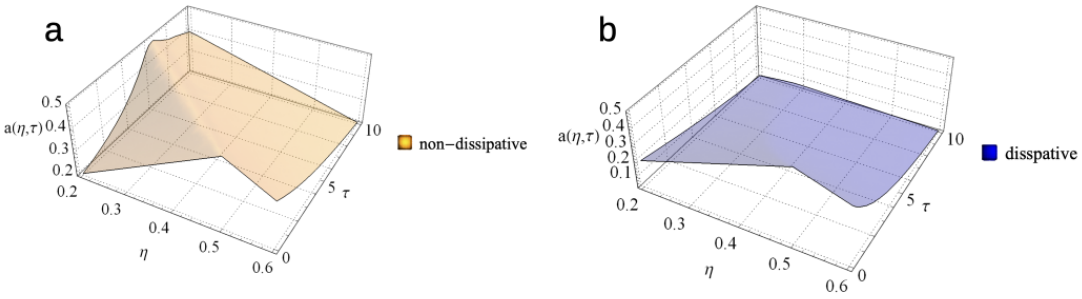

Figure 1: Examples of wave amplitude for a) non-dissipative and b) dissipative material models

References

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[4]Cormack J. M. (2021). Plane nonlinear shear wave propagation in transversely isotropic soft solids. The Journal of the Acoustical Society of America, 150(4), 2566-2576.

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