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Several excellent papers have appeared in PRSA in recent years on the seemingly solved topic of waves in elastic plates. But many questions remain, such as the existence of localised modes, whether guided by a topographic hump or trapped near a free edge. These are easy problems to pose but difficult to answer in a satisfactory manner. This short paper very ably resolves the question of existence of pure modes trapped at the end of a semi-infinite strip. A pure mode is a propagating Rayleigh-Lamb plate mode that reflects without loss or mode change from the free edge. The authors use a variety of high-powered constructive arguments to show that such a mode does indeed exist but only if the Poisson's ratio of the plate is either zero or 0.224. The methods employed are instructive and novel. For instance, an efficient algorithm based on recursive Gram determinants is described for numerically estimating the complex wave numbers of evanescent edge modes. The paper has a nice mix of physical insight and mathematical trickery, which together make for a splendid example of theoretical and applied mechanics.

Eigenvalue of a semi-infinite elastic strip by V. Zernov, A.V. Pichugin, J. Kaplunov

Abstract:

A semi-infinite elastic strip, subjected to traction free boundary conditions, is studied in the context of in-plane stationary vibrations. By using normal (Rayleigh–Lamb) mode expansion the problem of existence of the strip eigenmode is reformulated in terms of the linear dependence within infinite system of normal modes. The concept of Gram's determinant is used to introduce a generalized criterion of linear dependence, which is valid for infinite systems of modes and complex frequencies. Using this criterion, it is demonstrated numerically that in addition to the edge resonance for the Poisson ratio ?=0, there exists another value of ??0.22475 associated with an undamped resonance. This resonance is best explained physically by the orthogonality between the edge mode and the first Lamé mode. A semi-analytical proof for the existence of the edge resonance is then presented for both described cases with the help of the augmented scattering matrix formalism.