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Nonlinear free vibration analysis of laminated orthotropic cylindrical shells. (English)

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Summary: We present a method to predict the influence of geometric nonlinearities on the natural frequencies of an empty laminated orthotropic cylindrical shell. It is a hybrid of finite element and classical thin shells theories. Sanders-Koiter nonlinear and strain-displacement relations are used. Displacement functions are evaluated using linearized equations of motion. Modal coefficients are then obtained for these displacement functions. Expressions for the mass, linear and nonlinear stiffness matrices are derived through the finite element method (in terms of the elements of the elasticity matrix). The uncoupled equations are solved with the help of elliptic functions. The frequency variations are first determined as a function of shell amplitudes and then compared with the results in the literature.

MSC:

74H45 Vibrations in dynamical problems in solid mechanics
74K15 Membranes
74S05 Finite element methods applied to problems in solid mechanics

Keywords:

Sanders-Koiter strain-displacement relations; geometric nonlinearities; natural frequencies; linearized equations of motion; nonlinear stiffness matrices; elliptic functions

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