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Chaotic vibrations and stiff stability loss of shells with constant and variable thicknesses

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ABSTRACT

In this work chaotic vibrations of deterministic geometrically nonlinear elastic spherical and conical axially symmetric shells with constant and non-constant thicknesses and subjected to transversal sign changeable load using the variation principle are studied. Shell material is isotropic and the Hook law holds. Inertial forces in direction of tangents to a middle surface and the rotational inertia of normal shell cross sections are neglected. Transition from partial to ordinary differential equations (Cauchy problem) is carried out with a help of the Ritz procedure. Then the obtained Cauchy problem is solved using the fourth order Runge-Kutta method. Numerical analysis is supported by theory of nonlinear dynamical systems and the qualitative theory of differential equations.

Comparison of results obtained for the conical and spherical shells show that shell with boundary condition of the moving clamping and with increased thickness of their ends exhibit smaller both chaotic and stiff stability zones in comparison to shells with constant thickness. Having this in mind one may change the shell thickness and then choose parameters q_0 and ω_p appropriately in order to remove sudden increase of shell vibration amplitude.

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