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CHAOTIC VIBRATIONS OF BEAMS, PLATES AND SHELLS

Contact author:
J.A. (Jan) Awrejcewicz
Technical University of Łódź, Łódź, Poland
awrejcew@p.lodz.pl

Co-author(s):
A.V. Krysko, *Saratov State University, Saratov, Russian Federation*

In this work a unified theory of chaotic vibrations of beams, plates and shells is proposed. Mathematical models of multilayer systems for different kinematic models of Kirchhoff-Love, Timoshenko and generalized Timoshenko layers are constructed. In what follows geometrical nonlinearities (T. von Kármán equations match deformations and stresses), physical nonlinearities (nonlinear Hook's law), as well as factors of discontinuities between layers are taken (mathematical model as well as the algorithm of computation of unknown contact zone between layers after lack of their contact is given, and various models of linear and nonlinear damping are studied. The mentioned mathematical models are obtained owing to 3D theory and the Hamilton variation approach. In order to solve the obtained PDEs, a finite difference method, both Bubnov-Galerkin and Ritz approaches in higher approximations are applied. Finally the problem is reduced to ODEs solved via Runge-Kutta methods. This choice of reduction of PDEs to ODEs, and then application of various Runge-Kutta routines is motivated by highly accurate detec-tion, observation and control of chaos exhibited by multidimensional objects like plates and shells.

Owing to proposed mathematical and numerical models, complex vibrations of homogeneous and non-homogeneous plates and shells with an arbitrary geometry (spherical, cylindrical, conical, shallow, rectangular and sector ones) can be studied. The following numerical indicators are applied: signals, phase and modal por-traits, power spectra, FFT, wavelet transformation, Poincaré maps and Lyapunov's exponents.

New scenarios to chaos are illustrated and discussed in our investigated conservative and dissipative mechanical objects.