NONLINEAR MECHANICS AND TESTING OF HIGHLY FLEXIBLE ONE-DIMENSIONAL STRUCTURES USING A CAMERA-BASED MOTION ANALYSIS SYSTEM

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ABSTRACT

Both experimental and theoretical investigations are conducted for the dynamics of cables and strings. The exact equations of motion for finite but small amplitude vibration of string were derived based on a fully nonlinear model. The bifurcations of the modulated solutions were studied by investigating the influence of variation of excitation frequency and amplitude. Nonlinear phenomena like period-doubling, appearance of chaotic attractors, attractor transitions, and boundary crisis destroying the attractors of the Hopf branch and the isolated branch solutions were investigated.

A 3D motion analysis system was used to perform dynamic testing on vibrations of strings and cables. Experimental frequency response curves were obtained and analyzed. Linear and nonlinear modal couplings, causing isolated and simultaneous internal resonances, were observed and investigated.

The large deformation packaging of a highly flexible triangular frame was also studied.