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Paper 53

On the Lyapunov Exponents Computation of Coupled Non-Linear Euler-Bernoulli Beams

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In this work the mathematical modeling and analysis of the chaotic dynamics of flexible Euler-Bernoulli beams is carried out. The Karman-type geometric non-linearity is taken into account. The algorithms reducing the studied objects associated with the boundary value problems are to the Cauchy problem using the finite difference method (FDM) with an approximation of $O(c^2)$ and the finite element method (FEM). The constructed Cauchy problem is solved using the fourth and six Runge-Kutta methods. The validity and reliability of the obtained results is rigorously discussed. We analyze time histories, phase and modal portraits, autocorrelation functions, the Poincarè and pseudo-Poincarè maps, signs of the first four Lyapunov exponents, as well as the compression factor of the phase volume of an attractor. In particular, we study a transition from symmetric to asymmetric vibrations, and we explain this phenomenon. Vibration-type charts are reported regarding two control parameters: the amplitude and the frequency of the uniformly distributed periodic excitation. Furthermore, we have detected and illustrated chaotic vibrations of the Euler-Bernoulli beams for different boundary conditions and different beam thicknesses.