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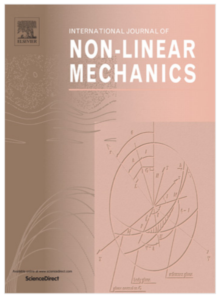

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On reliability of chaotic dynamics of two Euler-Bernoulli beams with a small clearance

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Abstract

A methodology to detect true chaos (in terms of non-linear dynamics) is developed on an example of a structure composed of two beams with a small clearance. The Euler-Bernoulli hypothesis is employed, and the contact interaction between beams follows the Kantor model. The complex non-linearity results from the von Kármán geometric non-linearity as well as the non-linearity implied by the contact interaction. The governing PDEs are reduced to ODEs by the second-order Finite Difference Method (FDM). The obtained system of equations is solved by Runge-Kutta methods of different accuracy. To purify the signal from errors introduced by numerical methods, the principal component analysis is employed and the sign of the first Lyapunov exponent is estimated by the Kantz, Wolf, Rosenstein methods and the method of neural networks. In the lattermost case, a spectrum of the Lyapunov exponents is estimated. It is illustrated how the number of nodes in the FDM influences numerical results regarding chaotic vibrations. It is also shown that an increase in the distance between beams implies stronger action of the geometric non-linearity. Convergence of the used numerical algorithm for FDM is demonstrated. The essential influence of initial conditions on the numerical results of the studied contact problem is presented and discussed.