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The contact interaction of a nano-plate supported by nano-beams in the temperature field

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Abstract: In this work a mathematical model of nonlinear dynamics and contact interaction of a nano-plate, supported by a local set of nano-beams under conditions of external dynamic and temperature influences is proposed. It includes the kinematic model of approximation for the plate and for the beams . The contact interaction between nano-plate and nano-beams is governed by the Winkler model. This mathematical model describes the work of composite elements of micromechanical systems. Algorithms for calculating the contact interaction of plate-beam nano-structures have been developed. The temperature fields for the plate (three-dimensional) and the beams (two-dimensional) are determined separately from the heat equation by the method of finite differences of the second and fourth order of accuracy. Next, the obtained set of non-linear PDEs is reduced to Cauchy problems using the Faedo-Galerkin approach in higher approximations and methods of finite differences of the 2nd and 4th order of accuracy. The Cauchy problems are solved by various methods of the Runge-Kutta types. Several methods for analyzing the sign of the largest Lyapunov exponent are used to determine the type of vibrations of a plate-beam nano-structures: the methods of Wolf, Kantz, and Rosenstein. This ensures the reliability of the solutions obtained and reveals the “truth” of chaos if the vibrations are chaotic. Examples of computations are presented. Acknowledgement This work has been supported the Ministry of Education and Science of the Russian Federation by the Grant № 2.1642.2017

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