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Nonlinear dynamics of flexible nanoplates resting on an elastic foundation in a stationary temperature field

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Abstract: Microsystem technology (MST) as well as nanotechnology (NT) are considered revolutionary technologies that determine the direction of the development of strategically important branches of mechanical engineering including space, military, medical and IT technologies, instrumentation for scientific research as well as micro-robotics. In this study, a mathematical model of a flexible nanoplate resting on an elastic foundation and subjected to the temperature field and transverse alternating loads is constructed. Main hypotheses: the body is elastic and isotropic; the hypothesis of the first approximation (Kirchhoff) is taken; geometric nonlinearity is introduced using the von Karman model; nanostructures are described by the modified couple stress theory of elasticity; temperature field model is based on the Duhamel-Neumann assumptions. Nanoplates governing equations of motion are yielded by the Hamilton's principle. As a method of reduction to the Cauchy problem, the method of finite differences in the spatial coordinate of the second order of accuracy is adopted. To determine the stationary temperature field, methods of variational iterations and the generalization of the Galerkin method are employed. The 3D heat equation is solved for the boundary conditions of the first/second/third kind. The Cauchy problem is solved by one of the Runge-Kutta type methods. We study the convergence of the solution depending on the number of partitions of the domain of integration versus a number of values of the size-dependent parameter.

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