MATHEMATICAL MODELING OF NONLINEAR VIBRATIONS OF A ROPE WITH A MOVING BOUNDARY

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УДК 534.11

DOI: 10.33184/mnkuomsh2t-2021-10-06.87.

Until now, the problems of longitudinal - transverse vibrations of objects with moving boundaries were solved mainly in a linear setting, the energy exchange through the moving boundary and the interaction between longitudinal and transverse vibrations were not taken into account. The paper presents a new nonlinear mathematical model of transverse vibrations of an unbounded rope with a moving boundary, in which geometric nonlinearity is taken into account. The obtained mathematical model allows one to describe high-intensity vibrations of a rope with a moving boundary.

Keywords: nonlinear mathematical model, vibrations of a rope, moving boundaries

Until now, the problems of longitudinal - transverse vibrations of objects with moving boundaries were solved mainly in a linear setting, the energy exchange through the moving boundary and the interaction between longitudinal and transverse vibrations were not taken into account [1–5, 7–10]. In rare cases, the action of the forces of resistance of the external environment was taken into account [6]. Real technical objects are much more complicated, for example, with an increase in the intensity of oscillations, the geometric nonlinearities of the object have a great influence on the oscillatory process. In connection with the intensive development of numerical methods, it became possible to more accurately describe complex mathematical models of longitudinal-transverse oscillations of objects with moving boundaries, taking into account a large number of factors influencing the oscillatory process. The paper presents a new nonlinear mathematical model of longitudinal-transverse vibrations of a rope with a moving boundary, which takes into account geometric nonlinearity, viscoelasticity, energy exchange across the boundary. The boundary conditions are obtained in the case of interaction between the parts of the object to the left and to the right of the moving boundary. The

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resulting model is linearized. In this case, the principle of homogeneity is observed: in the particular case of small fluctuations, the obtained linear models coincided with the classical ones, which indicates the correctness of the results obtained. The obtained mathematical model allows one to describe high-intensity vibrations of a rope with a moving boundary.

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