ACTIVE CONTROL OF NONSTATIONARY VIBRATIONS IN PLATES UNDER DYNAMIC LOADING

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ABSTRACT

The current study is devoted to the development of active control methods for the nonstationary vibrations of the rectangular isotropic elastic plate of medium thickness under dynamic transverse concentrated loading P(t) (Fig. 1).

The direct problem (finding the dynamic distribution of the plate deflection) is solved analytically. The system of partial differential equations is solved using the Fourier series and the Laplace integral transform. The solution is written in the form of the Duhamel integral (of the convolution type) with finite-difference Cauchy kernels.

To solve the vibration control problem (to minimize or, if possible, fully eliminate the deflection) the additional control loads $P^c(t)$ are applied to the mechanical system. The necessary control loads are determined from the solution of system of Volterra integral equations, which has been obtained on the base of the direct problem solution. Furthermore, Tikhonov regularization algorithm is used to numerically solve the ill-posed system of equations (system of Volterra integral equations). An appropriate choice of the control loading points the distribution of the loading in time can significantly reduce the amplitudes of normal displacements of the plate [1, 2].

An approximate solution of the problem is obtained using the numerical-analytical method. The resulting deflections of the median plane are presented for different combinations of the disturbing load and control functions. The advantages and disadvantages of particular control systems and possibility of their practical implementation are discussed.

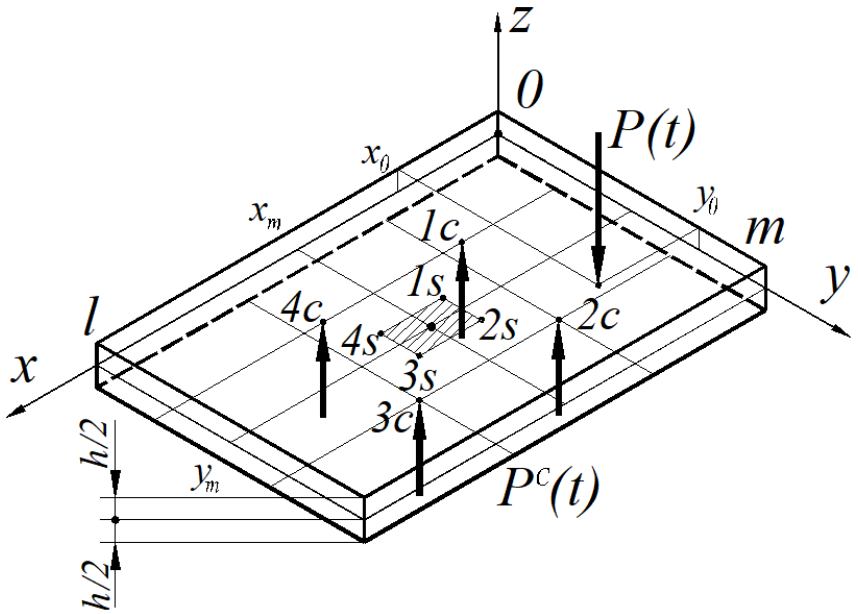

Figure 1: Plate under dynamic loading

Keywords: Volterra Integral Equation, Timoshenko Plate, Nonstationary Loading, Vibration Control, Inverse Problem, Ill-posed Problem; Tikhonov Regularization.

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