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APPLICATION OF THE R-FUNCTIONS THEORY AND SPLINE-APPROXIMATION TO FINDING EIGEN FUNCTIONS AS BASIC ONES FOR MESHLESS DISCRETIZATION OF THE LAMINATED SHALLOW SHELLS

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ABSTRACT

Investigation of the nonlinear dynamic behavior of composite laminated shallow shells in most cases is based on presentation of solution in a form of series by linear eigenfunctions. The proposed alternative method to extract eigenfunctions of the problem is based on the spline-approximation and the R-functions method (RFM). The first-order theory for multilayered shallow shells taking into account the shift deformations is used in a variational form.

Multilayered shells are widely spread in modern industry. The combination of advantageous features of composite materials and thin walled structures plays the principal role in the final designer choice. Composite materials allow create lighter constructions remaining sufficiently stiff and maintaining their strength. The choice of lamination schemes is an advanced option adding more flexibility than any isotropic material could give. On the other hand the thin walled elements maintain their stiffness and permit to decrease the used material amount. That is why the investigation of multilayered shallow shell's dynamic behavior is relevant. This relevance is proved by a number of papers published in this area [1-3]. But there are at present a lot of unsolved problems on this subject.

In the most cases when the nonlinear behavior of shells is examined the solution function is introduced in a form of series by eigenfunctions of the linear boundary problem. The correct choice of these basic functions and their number in the series allows to obtain accurate results. In the present paper an effective method of the problem eigenfunctions extraction is proposed. It is based on the R-functions theory and the spline-approximation, which allows investigate a dynamics of shallow shells with complex forms and different boundary conditions [4]. The theory used to model shallow shell's behavior is the first-order theory taking into account the shift deformations. Numerical realization of the proposed approach is based on a combined usage of mathematical package Maple and specialized algorithms programmed in C++. Nonlinear dynamics of multilayered shallow shells is to be examined further.

REFERENCES

[1] Y.K. Cheung, Y.M. Fu Nonlinear static and dynamic analysis for laminated spherical caps of moderate thickness, *Nonlinear Dynamics*, No.8, pp. 251–268, 1995.

[2] N.V.S. Naidu, P.K. Sinha Nonlinear finite element analysis of laminated composite shells in hygrothermal environments, *Composite Structures*, No.69, pp. 387–395, 2005.

[3] L.V. Kurpa Nonlinear free vibrations of symmetrically laminated shallow shells with complex plan-form, *J. Math. Methods and Phis. Mech. Fields*, Vol.51, No.2, pp. 75-85, 2008 (in Russian).

[4] L.V. Kurpa, A.A. Osetrov Study of free vibrations of shallow shells using the R-functions method and the spline-approximation, *J. Math. Methods and Phis. Mech. Fields*, Vol.50, No.4, pp. 83-93, 2007 (in Russian).

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