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Fractional Derivative Expansion Method in Nonlinear Dynamics of Structures

M.V. Shitikova
Moscow State University of Civil Engineering
Russia

Abstract:

It has been shown the necessity to formulate the modified version of the method of multiple scales, which could be called, following Professor Nayfeh [1], *the fractional derivative expansion method*. It is the efficient method for studying the nonlinear dynamic response of structures, damping features of which depend on natural frequencies of vibrations.
For the first time, it has been suggested by Rossikhin and Shitikova in [2] that the fractional derivative model of viscoelasticity allows one to obtain the results which conform with experimental data obtained from the ambient vibration studies of suspension bridges. Moreover, the fractional parameter, i.e., the order of the fractional derivative, could be considered as a structural parameter of the whole system, since it could change the character of the system's damping ratio as a function of natural frequencies of linear vibrations.
Further, this method was applied for the analysis of different internal and combinational resonances in single-degree-of-freedom systems [3], beams, plates and shells [4]. It has been shown that the viscoelastic models involving fractional-order time derivatives are more suitable than the models with integer-order time derivatives for describing damping features of real structures.
This talk is devoted to the bright memory of Professors Ali H. Nayfeh and Yury A. Rossikhin. The nonlinear dynamic problems of soil-structure interaction will be considered using the fractional calculus models of viscoelasticity.

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