TRANSVERSE FREE VIBRATION OF ROTATING NON-UNIFORM EULER-BERNOULLI BEAMS USING THE ADOMIAN MODIFIED DECOMPOSITION METHOD

D. Adair*

School of Engineering, Nazarbayev University, Astana, Kazakhstan; *dadair@nu.edu.kz

Introduction. The dynamic behavior of non-uniform rotating beams is of practical interest since it is widely used in many engineering applications such as helicopter rotor blades, spinning space structures and gas turbine blades.

Problem. The equation for the problem to be solved describes the free vibration of a rotating non-uniform elastic beam,

$$\frac{d^2}{dx^2}\left[\frac{\partial}{\partial x}\left(\frac{\partial}{\partial x}\right) + pA(x)\right]\Pi = 0 \qquad 0<x<l$$

where T(x) is the axial force due to the centrifugal stiffening.

Method. A computation approach called the Adomain modified decomposition method (AMDM) is used to carry out the free transverse vibration analysis of rotating non-uniform Euler-Bernoulli beams using several boundary conditions, rotating speeds and beam lengths. The AMDM allows the governing differential equation to become a recursive algebraic equation and the boundary conditions become simple algebraic frequency equations suitable for symbolic computation.

Results. Results were found for convergence plots for the first three dimensionless natural frequencies, the first three mode shape functions, the effect of equal tapering on frequency parameters on a non-rotating cone cantilever beam, frequency parameters trends with equal taper ratios, and the effects of unequal tapering and hub radius parameter on the first frequency parameter.

Conclusions. This method gives an effective method for obtaining the closed-form series solutions of the free vibrations of non-uniform beams with flexible ends. It could be claimed that this method gives similar results to other more complicated schemes.

References.

1. Adomian G., Solving frontier problems of physics: The Decomposition Method, Kluwer
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