World Academy of Science, Engineering and Technology
International Journal of Mechanical and Materials Engineering
Vol:17, No:09, 2023

Natural Frequency Analysis of Spinning Functionally Graded Cylindrical Shells Subjected to Thermal Loads

Authors : Esmaeil Bahmyari

Abstract : The natural frequency analysis of the functionally graded (FG) rotating cylindrical shells subjected to thermal loads is studied based on the three-dimensional elasticity theory. The temperature-dependent assumption of the material properties is graded in the thickness direction, which varies based on the simple power law distribution. The governing equations and the appropriate boundary conditions, which include the effects of initial thermal stresses, are derived employing Hamilton's principle. The initial thermo-mechanical stresses are obtained by the thermo-elastic equilibrium equation's solution. As an efficient and accurate numerical tool, the differential quadrature method (DQM) is adopted to solve the thermo-elastic equilibrium equations, free vibration equations and natural frequencies are obtained. The high accuracy of the method is demonstrated by comparison studies with those existing solutions in the literature. Ultimately, the parametric studies are performed to demonstrate the effects of boundary conditions, temperature rise, material graded index, the thickness-to-length and the aspect ratios for the rotating cylindrical shells on the natural frequency.

Keywords : free vibration, DQM, elasticity theory, FG shell, rotating cylindrical shell
Conference Title : ICDMME 2023 : International Conference on Design, Mechanical and Material Engineering
Conference Location : Toronto, Canada
Conference Dates : September 18-19, 2023