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Stability Analysis of Thin-Walled Spinning Reinforced Pipes Conveying Fluid in Thermal Environment

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Abstract

The divergence and flutter instabilities of the thin-walled spinning pipes reinforced by single-walled carbon nanotubes in thermal environment are investigated. The material properties of carbon nanotube-reinforced composites are assumed to be uniform distribution as well as two types of functionally graded distribution patterns. The thermal effects are also considered and the material properties of carbon nanotube-reinforced composites are assumed to be temperature-dependent. The cantilever pipe conveying fluid is spinning along its longitudinal axis and subjected to an axial force at the free end. Based on the thin-walled Timoshenko beam theory, the governing equations of motion are derived using the extended Hamilton's principle and discretized via the Galerkin method. The resulting thermal-structural-fluid eigenvalue problem is solved and the frequency and the critical fluid velocities are calculated. The effects of carbon nanotubes distributions, volume fraction of carbon nanotubes, compressive axial force, spinning speed, gravity and fluid mass ratio on the critical divergence and flutter velocities of the thin-walled spinning pipe conveying fluid are studied.

Keywords: Spinning pipe conveying fluid; Flutter and divergence; Thermal environment.

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