Response analysis of rotor-blade systems through a reduced dynamical model

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Abstract

The problem of the dynamics of coupled rotor-blade systems, such as wind turbines, is considered. The blades are modeled as Euler-Bernoulli beams undergoing transverse vibration attached to a rotor in cantilever conditions with the longitudinal axis extending in a radial direction. The rotor is modeled as a lumped mass moving on a plane with different stiffness characteristics in each dimension. Interest is set to the vibration analysis of the ensemble and the interaction of its parts. The study of the evolution of vibration parameters such as critical speeds and resonant frequencies is carried out. The effect of loads acting on the beam are considered, and these are related to the torques generated on the beam and to the stresses that result at the base of the rotor. The model developed has a reduced number of degrees of freedom while preserving the essential dynamical properties. The viability of this model is explored for applications in domains such as fatigue estimation and stochastic analysis.

Keywords: Rotating beam, vibration, Rotordynamics

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