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Analytical Solution for the Aeroelastic Response of a Two-Dimensional Elastic Plate in Axial Flow CORY MEDINA, CHANG-KWON KANG, Univ of Alabama - Huntsville — The aeroelastic response of an elastic plate in an unsteady flow describes many engineering problems from bio-locomotion, deforming airfoils, to energy harvesting. However, the analysis is challenging because the shape of the plate is a priori unknown. This study presents an analytical model that can predict the two-way tightly coupled aeroelastic response of a two-dimensional elastic plate including the effects of plate curvature along the flow direction. The plate deforms due to the dynamic balance of wing inertia, elastic restoring force, and aerodynamic force. The coupled model utilizes the linearized Euler-Bernoulli beam theory for the structural model and thin airfoil theory as presented by Theodorsen, which assumes incompressible potential flow, for the aerodynamic model. The coupled equations of motion are solved via Galerkin's method, where closed form solutions for the plate deformation are obtained by deriving the unsteady aerodynamic pressure with respect to the plate normal functions, expressed in a Chebyshev polynomial expansion. Stability analysis is performed for a range of mass ratios obtaining the flutter velocities and corresponding frequencies and the results agree well with the results reported in the literature.

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