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Jacobi polynomial solution technique for the unsteady aerodynamics of porous airfoils[1] ROZHIN HAJIAN, Harvard University , PETER J. BADDOO, Imperial College London, JUSTIN W. JAWORSKI, Lehigh University — Recent research has uncovered analytic solution forms for the flow field past a thin airfoil with an arbitrary porosity distribution. However, efforts to extend this work to unsteady flows or airfoil motions fail due to the presence of extra terms in the singular integral equation that are not readily treated analytically. To circumvent this issue, the bound vorticity along the chord is expanded as a series of weighted Jacobi polynomials. Analytic expressions for the parameters of the Jacobi polynomials are derived via asymptotic analysis. This approach is shown to be valid for static airfoils in steady flows with either continuous or discontinuous porosity distributions. A numerical validation is presented that demonstrates the spectral convergence of the scheme. The mathematical method is then extended to consider the unsteady motions of porous airfoils where the classical singular integral approach breaks down.

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