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The effect of Viscous Boundary Condition On Kelvin's Conservation of Circulation: Modified Theodorsen Function AMIR S. REZAEI, HAITHEM TAHA, University of California Irvine — One of the essential tools that have been ubiquitously used in theoretical modeling of unsteady aerodynamics is Kelvin's law of zero total circulation. It implies that, for inviscid fluids, the total circulation in the fluid domain is conserved yielding a relation between the bound and wake circulation. In this study, we show that, by virtue of the viscous boundary condition (no slip), the vorticity generated on the fluid-solid interface (which is proportional to the angular velocity of the body) disturbs such a conservation law. Taking this viscous contribution into account, we developed an extension of Theodorsen's inviscid lift frequency response in the case of a pitching airfoil. The results show more phase lag and lift deficiency compared to Thodorsen's function, which have been reported by many scholars in the literature, and also validated against URANS simulations in this study.

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