

Abstract Submitted
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The Kutta-Zhukovsky Lift Theorem revisited: Alteration due to the Viscous Wake SVEN SCHMITZ, The Pennsylvania State University — The circulation theory of lift comprised in the classical Kutta-Zhukovsky Lift Theorem forms the foundation of modern aerodynamic wing theory. The theorem has been applied ever since in lifting-line models of aircraft and rotary wings. Reynolds numbers larger than one million support its validity, yet the effect of a viscous wake on a change in the functional relationship between lift and circulation is not taken into account in standard lifting-line analyses. A discrepancy in circulation of more than six percent in comparison to the classical Kutta-Zhukovsky Lift Theorem has been demonstrated by the author (Schmitz & Chattot, *Computers & Fluids*, **36**) for moderately separated flow around a wind turbine airfoil by means of a control volume analysis governed by the Navier-Stokes equations. The present work extends the previous analysis to general three-dimensional flow around a lifting body. An analytical expression is presented that extends the classical Kutta-Zhukovsky Lift Theorem by adding terms to the theorem due to chord- and spanwise vorticity transport. An integrated solution for induced drag is given that has not been documented in previous literature on the subject. The generalized theorem will find future application and quantification in actuator-line methods used to predict wind farm wake interactions with Atmospheric Boundary Layer flow.

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