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Vorticity Confinement Applied to Turbulent Wing Tip Vortices for Wake-Integral Drag Prediction[1] KRISTOPHER PIERSON, ALEX POVITSKY, The University of Akron — In the current study the vorticity confinement (VC) approach was applied to tip vortices shed by edges of stationary wings in order to predict induced drag by far-field integration in Trefftz plane. The VC parameter was evaluated first by application to convection of vortices in 2-D uniform flow and then to tip vortices shed in 3-D simulation of finite-aspect ratio rectangular wing in subsonic flight. Dependence of VC parameter on the flight Mach number and the angle of attack was evaluated. The aerodynamic drag results with application of VC to prevent numerical diffusion are much closer to analytic lifting line theory compared to integration over surface of wing while the viscous profile drag is more accurately evaluated by surface integration. To apply VC to viscous and turbulent flows, it is shown that VC does not affect the physical rate of dissipation of vortices in viscous/turbulent flows at time scales corresponding to convection of vortices from the wing to Trefftz plane of integration. To account for turbulent effects on tip vortices, VC was applied in combination with Spalart-Allmaras, k-ε, and six Reynolds stresses models of turbulence. The results are compared to experiments to validate the physical dissipation of tip vortex.

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