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Transient Vortex Structures in the Near Wake of a Wing during Pitch Up/Down Maneuvers[1] EMILIO GRAFF, MORGANE GRIVEL, California Institute of Technology, DAVID WILLIAMS, Illinois Institute of Technology — The vorticity distribution in the wake of a thin airfoil reflects the lift and bound circulation history of the wing. During a pitch-up maneuver from 0 degrees to some higher angle of attack (assuming attached flow), a "starting vortex" is formed in the wake whose circulation is opposite in strength to the bound circulation in the wing. However, a finite time is required for the starting vortex to fully develop, and if the wing pitches down to a smaller angle of attack before the first starting vortex has reached full strength then an imbalance in the wake circulation occurs. The delay time between the up/down pitch motions and the maximum angle of attack determine which additional vortices must be formed to satisfy Kelvin's theorem. In addition to the irrotational flow vortices that form, vorticity associated with the viscous boundary layers also accumulates into discrete vortices that accompany each "starting vortex." The complicated distributions of vortices and their evolution in the wake are examined with detailed PIV, smoke-visualization, and numerical simulations at Re = 240 to 70,000.

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Emilio Graff
California Institute of Technology

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