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Simulation and Control of Separated Flow over Low-Aspect-Ratio Airfoils[1] KUNIHIKO TAIRA, TIM COLONIUS, California Institute of Technology — Direct numerical simulation is used to study the three-dimensional formation and evolution of wake vortices behind low-aspect-ratio, flat-plate airfoils at a Reynolds number of 300. For impulsively-started translation at high angles of attack, flow separates and forms leading-edge and tip vortices that interact as they detach from the plate. Since added spanwise circulation enhances lift exerted on the plate, it is useful to prevent the leading-edge vortex from shedding. Stabilizing mechanisms for the leading-edge vortex are identified to be the downward induced velocity from the tip vortices and the release of vorticity through diffusion and spanwise convection. Aspect ratio, planform geometry, and angle of attack are varied to examine differences in the convection of vorticity and influence of tip vortices. Flow control by momentum injection (blowing) is also considered at various locations and is found to alter the vortical wake structure by strengthening the tip vortices inducing stronger downward velocity. Such controlled flows enhanced lift and, in some instances, achieved a stable steady state.

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