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Numerical Simulations of Natural and Actuated Flow over a 3D, Low-Aspect-Ratio Airfoil GUILLAUME BRÈS, Exa Corporation, DAVID WILLIAMS, Illinois Institute of Technology, TIM COLONIUS, California Institute of Technology — Numerical simulations of the unsteady flow over a low-aspect-ratio, low Reynolds number semi-circular planform wing are performed using Lattice Boltzmann method. The simulations exactly match the flow conditions and the detailed geometry from previous wind-tunnel experiments, including the flow actuators installed internally along the leading edge of the wing. To reproduce the pulsed-blowing actuation used in the experiment, a single pulsed square wave forcing is imposed in the simulations as a mass flow boundary condition in the actuators. Three angles of attack, with the active flow control both on and off, are investigated. For both mean and unsteady lift and drag, the numerical simulations show good agreement with the experiments. In particular, the transient increase in lift after the forcing is turned off is well captured in the simulations. Both PIV measurements and transient numerical results indicate that this behavior is associated with the advection of large vortical structures generated by the flow actuation at the leading edge.

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