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The leading-edge vortex and quasi-steady vortex shedding on an accelerating plate[1] KEVIN CHEN[2], TIM COLONIUS, California Institute of Technology, KUNIHIKO TAIRA, Princeton University — A computational inquiry focuses on leading-edge vortex (LEV) growth and shedding during acceleration of a 2-D flat plate at a 30° angle of attack and at low Reynolds number. The plate accelerates from rest with a velocity given by a power of time ranging from 0 to 5. Comparison with Wagner's inviscid theory of airfoils reveals a lift coefficient peak across all powers during the initial LEV growth. The peak universally lasts four to five chord lengths of translation. A pattern of leading- and trailing-edge vortex shedding follows the shedding of the initial LEV. Plotted against Reynolds number, the nondimensional frequency, lift coefficient maxima, and lift coefficient minima of the shedding pattern closely match their values in the absence of acceleration. This leads to the support of a quasi-steady theory of vortex shedding, where dynamics are determined primarily by Reynolds number and not acceleration. Finally, the time scale of the lift augmentation matches well with the half-stroke of a flying insect, and supports a nondimensional vortex formation time close to 4.

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