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Three-dimensional instabilities of vortices shed from a plunging wing: Computations[1] AN-KANG GAO, SPENCER J. SHERWIN, CHRIS D. CANTWELL, Department of Aeronautics, Imperial College London, United Kingdom — The three-dimensional (3-D) instability of leading-edge vortex (LEV) in the flow past a plunging wing is studied numerically using the open source spectral element code, Nektar++. The plunging motion has a reduced frequency of k=2, and a peak-to-peak amplitude of A/c=0.5. The effect of Reynolds number based on the chord length c and incoming flow velocity is explored in the range from 200 to 10000. BiGlobal linear stability analysis shows an unstable mode with a spanwise wavelength longer than 1.5c exits for Re >= 400. This wavelength increases with Reynolds number. In this unstable mode, the LEV forms a bending mode; the back and forth flow around the leading edge is the main cause of instability. 3-D direct numerical simulation of infinite wing shows the disturbed LEV has a saturate peak-to-peak bending amplitude of 0.06c during the upward stroke and that it breaks down in the downward stroke. Numerical simulation of finite wing is also conducted. Excellent agreement is found between the current numerical result and experimental result (see the Experiments part). Unlike the infinite span case, LEV of the finite wing forms a helical mode and its wavelength is around 1c.

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An-Kang Gao
Department of Aeronautics, Imperial College London, United Kingdom

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