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**The leading-edge stall of airfoils with various nose shapes**

MATTHEW KRALJIC, ZVI RUSAK, Rensselaer Polytechnic Institute, SHIXIAO WANG, U Auckland, NZ — We study the inception of leading-edge stall on stationary, smooth thin airfoils with various nose shapes of the form $x^a$ (where $0 < a < 1/2$) at low to moderately high chord Reynolds number flows. A reduced-order, multi-scale model problem is developed and solved using numerical simulations. The asymptotic theory demonstrates that a subsonic flow about a thin airfoil can be described in terms of an outer region, around most of the airfoils chord, and an inner region, around the nose, that asymptotically match each other. The flow in the outer region is dominated by the classical thin airfoil theory. Scaled (magnified) coordinates and a modified (smaller) Reynolds number $Re_M$ are used to correctly account for the nonlinear behavior and extreme velocity changes in the inner region, where both the near-stagnation and high suction areas occur. The inner region problem is solved numerically to determine the inception of leading-edge stall on the nose. It is found that stall is delayed to higher angles of attack with the decrease of nose parameter $a$. Specifically, new airfoil shapes are proposed with increased stall angle at subsonic speeds and higher critical Mach numbers at transonic speeds.

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