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Explanation of the effects of leading-edge tubercles on the aerodynamics of airfoils and finite wings[1] MEHDI SAADAT, HOSSEIN HAJ-HARIRI, University of Virginia, FRANK FISH, West Chester University — A computational study was conducted to explain the aerodynamic effect of leading edge tubercles on maximum lift coefficient, stall angle of attack (AoA), drag, and post stall characteristics for airfoils as well as finite wings. Past experiments demonstrated airfoils with leading edge tubercles do not improve Cl_{max}, drag, or stall AoA but smoothen post stall characteristics to a great degree. In contrast to airfoils, finite wings with L.E. tubercles improved all aerodynamic characteristics. We explain the stall mechanism of the tubercled wing by considering each L.E. tubercle as a combination of a swept forward and a swept backward wing.There are 3 mechanisms (streamline curvature, accelerated stall, and upwash) that cause Cl_{max} of airfoils with L.E. tubercles always be lower than that of smooth airfoils. We also identify two additional mechanisms which are responsible for improved post-stall characteristics of airfoils with L.E. tubercles. Finally, we discuss why finite wings with L.E. tubercles have higher Cl_{max} and lower drag than their smooth L.E. counterparts by studying effects of wing tip, sweep, and taper ratio.

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