LIFT ENHANCEMENT BY TRAPPED VORTEX AT ULTRA-LOW REYNOLDS NUMBERS

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Abstract

A means of passively trapping a vortex to enhance the aerodynamic characteristics of an airfoil is explored in this paper. The flow over an airfoil with a cavity on the upper surface, an NACA 0004 airfoil, and a flat plate airfoil is studied computationally in the ultra-low Reynolds number regime. At low angles of attack a vortex is seen to be trapped in the cavity. With increasing angle of attack the trapped vortex grows in size and occupies the entire cavity and the effective geometry resembles a smooth airfoil. The vortex circulation also increases and enhances the lift characteristics of the airfoil. The drag coefficient of the cavity airfoil is comparable to the NACA 0004 airfoil. The lift-to-drag ratio of the cavity airfoil is found to be higher than the smooth airfoils in the entire range of angles of attack considered in the present study. The cavity airfoil, with a trapped vortex, offers an interesting prospect for engineering nano-air vehicles.

Keywords: Ultra-low Reynolds Number Flow, Cavity, Trapped Vortex, Lift Enhancement