Effect of turbulence intensity on an ultra-low Reynolds number airfoil wake

Wang S, Zhou Y#

Department of Mechanical Engineering, The Hong Kong Polytechnic University, Hong Kong

Corresponding author: mmyzhou@inet.polyu.edu.hk

Abstract

The work investigates the effect of the turbulence intensity T_u of the oncoming flow on the wake of an NACA 0012 airfoil at chord-based Reynolds numbers, i.e., Re = 5300 and 20000. T_u was varied from 0.6% to 6.0%. While the lift and drag coefficients (C_L and C_D) of the airfoil were estimated using a load cell, the flow was measured using the laser-induced fluorescence (LIF) flow visualization and particle image velocimeter (PIV) techniques. It has been found that at Re = 5300 the airfoil stall is absent for T_u = 0.6% but evident for T_u = 6.0%. Accordingly, the drag and list coefficients exhibit a marked difference. As airfoil angle of attack varies, three distinct types of shear layers over the airfoil are identified and characterized for Re = 5300 and T_u = 0.6% but four for higher Re or T_u. The critical Re at which the separation bubble starts to occur reduces with higher T_u. The effect of increasing T_u on flow bears similarity to that of increasing Re, though difference does occur.