EFMC11. 11th European Fluid Mechanics Conference

Comunicación núm. 650

INFLUENCE OF MICRO-BLOWING TECHNIQUE ON SKIN FRICTION OF BOUNDARY LAYER FLOWS

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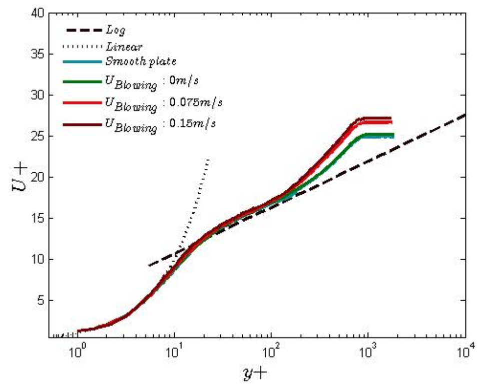
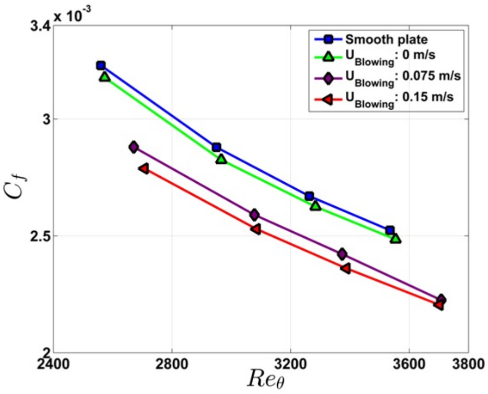
Viscous influence in turbulent boundary layer contributes a significant share of frictional drag. Previous investigation has proved uniform Micro-Blowing Technique (MBT) as a very promising concept to reduce a major share of the skin friction (Kornilov, JEPaT, 88, 1500, 2015 & Motuz, GALA, 19, 2012). In this experiment, non-intrusive Laser Doppler Anemometry (LDA) was applied to carry out a series of measurements on a zero pressure gradient flat plate. Smooth and perforated surfaces were used for 16 different momentum thickness Reynolds numbers ranging from 2476 to 3700. The amplitude of the blowing air through the perforated surface was varied between 0.25 % - 0.35 % of the free stream velocity at a fixed streamwise location of 58 %. To a maximum of 14 % Drag reduction was achieved with MBT, a quantitative analysis of friction coefficient as a function of flow Reynolds number is discussed. Flow visualization images exhibit induced turbulent structures at the edge of the boundary layer compared to the structures observed over smooth surface. Additionally, boundary layer thickness increases as the amplitude of blowing air increases. Corresponding Mean profiles of streamwise velocity and normalized statistics of fluctuating data is found to be in good agreement with numerical data (Kametani, IJHFF, 55, 136, 2015). As a consequence of blowing, gradient of the streamwise velocity fluctuation in outer region is strongly influenced in contrast to the first peak. Further investigations aiming to understand the influence of blowing on the turbulent structures in outer region are necessary to explain the drag reduction mechanism.



Profiles of the mean velocity in inner-law scaling at momentum thickness Reynolds no: 2476



Friction coefficient as a function of momentum thickness Reynolds number