TURBULENT BOUNDARY LAYER STATISTICS UNDER THE INFLUENCE OF UNIFORM MICRO-BLOWING

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Abstract

Uniform blowing as a mean to control turbulent boundary layer flows has been widely investigated [**?**], but the nature of interaction between main flow over permeable surface and blowing from it is still not fully understood. We report on experiment regarding control over turbulent boundary layer flow using uniform micro-blowing. To obtain a uniform vertical flow from the surface, a finely perforated blowing device was used in conjunction with a single air compressor [**?**]. Statistical approach upto fourth order has been adopted to analyze the influence of such uniform blowing on turbulent boundary layer parameters. Results presented here were obtained from data using Particle Image Velocimetry (*PIV*) in two different wind tunnel facilities and two experimental setups with corresponding parameter scaling of micro-blowing devices. Boundary layer wind tunnel facility at Brandenburg Technical University was used to investigate turbulence statistics at $Re_\theta = 1800 \sim 3700$ [**?**]. To understand the Reynolds number effect at higher range, measurements were carried out at large boundary layer wind tunnel facility of Laboratoire Méchanique de Lille. A short description of the facility can be found in reference [**?**]. In order to compare the statistics of control effects to those of uncontrolled one, a reference experiment on smooth surface in the range of $Re_\theta = 7630 \sim 18950$ was conducted. Blowing air from permeable surface was applied vertically and its magnitude was varied in the range of $1\% \sim 5\%$ of free stream velocity (U_∞). Data statistics obtained from experiments on both wind tunnels are compared. It was observed, that the boundary layer thickness is increased despite weak amplitude of the blowing compared to the reference flow. The increment reduces along the streamwise direction at all Reynolds numbers. With increasing blowing amplitude, outer peak of the streamwise turbulence intensity generally associated with large scale structures. A comparative study of blowing effect on outer peak dependence of Reynolds number is discussed.

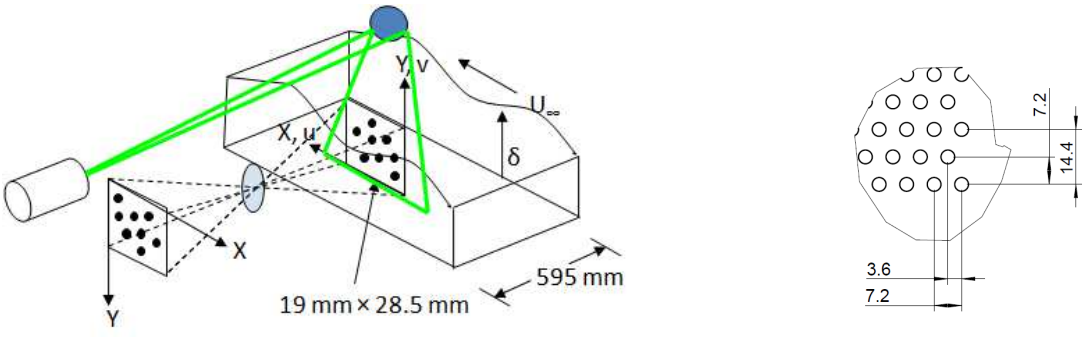

Figure 1: Schematic of PIV setup at LAS (**Left**). Schematic of perforated surface at LML (**Right**)

References

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