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Laser Doppler Anemometry Investigation on Sub Boundary Layer Vortex Generators for flow control

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ABSTRACT

A three component Laser Doppler Anemometry (LDA) system has been used as the primary measurement instrument for a programme of work investigating the fundamental behaviour of sub boundary layer vortex generators. Report on the effect of SBVG on three common flows of interest; a zero pressure gradient, an equilibrium pressure gradient and a 2D turbulent boundary layer flow separation. Four Generic designs of passive vortex generator have been studied and one active design using pulsed air jets².

Studies have been performed in the DERA Bedford Boundary Layer Tunnel. The tunnel is of open return design with a long working section 1.2m wide by a nominal 0.3m high. The tunnel floor is flexible and the growth of boundary layers along the working section can be controlled by the developed local pressure gradient¹. More highly complex flows can be achieved by additionally fixing flow-forming structures within the working section. The LDA system used two TSI fibre optic coupled probe units fitted with beam expansion optics and 205mm diameter, 1540mm focal length lenses. Probes were configured as a symmetric system with a subtended half angle of 20.1° and mounted on a 0.6m motion three-axis traverse. Data collection utilised Dantec enhanced BSA processors and software.

Results presented characterise downstream circulation, vortex position, trajectory and persistence with methods of SBVG classification by non-dimensional parameters. The effect of pressure gradient on downstream flow is demonstrated. It is shown that SBVG devices with heights in the order of only one quarter of the boundary layer can significantly reduce the size of regions containing turbulent boundary layer separated flow.