Stereo PIV measurements of Suction and Pulsed Blowing Interaction with a Laminar Boundary Layer

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HIGHLIGHTS

• Stereo PIV measurements were successfully conducted on a flat plate boundary layer with active flow control (AFC).
• A novel actuator was used as an active flow control device utilizing steady suction and oscillatory blowing.
• Complex 3D vortical structures were identified using the SPIV measurements which were not apparent before when Hot-Wire was the main measurement tool.
• A better understanding of the drag reduction and boundary layer thinning mechanisms has been achieved.

ABSTRACT

This paper focuses on measurements of laminar flow along a flat plate and its interaction with suction and oscillatory blowing. This interaction generates complex structures in the flow which supplement boundary layer measurements using Hot-Wires. With the SPIV setup it is possible to measure all 3 velocity components and to calculate the 3 vorticity components and therefore to obtain a comprehensive understanding of the effects of the active flow control on the boundary layer. Special effort has been put in designing and calibrating the SPIV system so that a sub mm resolution can be achieved for all 3 velocity components in a cross flow plane. The results clearly identify the flow structures developed by the interaction between the laminar boundary layer and the AFC in the form of suction and the oscillatory blowing, and also a reduction in the boundary layer thickness can be quantified.