

Endoscopic Stereoscopic PIV Measurements in Turbomachines

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For several years Particle Image Velocimetry (PIV) has been successfully used for the determination of planar velocity fields. With the introduction of the Stereoscopic PIV (SPIV) all components of internal velocity fields can be captured in enclosed spaces. This method has proved to be particularly suitable for the investigation of strongly unsteady, turbulent flow structures in turbomachines.

However, compared to conventional applications, PIV measurements in turbomachines are more challenging. Limited access to measurement section, light reflections, camera calibration, and machine vibration must be taken into account, to name but a few. The implementation of endoscopic PIV in turbomachines gives an advantage for investigating more complex measurement setups and even real machines.

At the Institute of Turbomachinery and Fluid Dynamics (TFD), endoscopic PIV is developed and applied to different turbomachines, for instance to the axial diffuser test rig, which is a 1:10 scaled model of a heavy duty gas turbine exhaust diffuser. The purpose of the PIV measurement is to capture unsteady structures in the diffuser flow and to find information about their influence on the flow separation. Microspheres are used for seeding.

In a more complex test rig of a 700 kW 7-stage air turbine, SPIV is employed to study the wake structures behind the last stage. For a medium loading with 40% mass flow and 83% of design speed, 3-component velocity fields are recorded.

In a third application, the IGV-impeller interaction is investigated by means of SPIV, in the centrifugal compressor test facility. Here, section-wise SPIV measurements, accompanied by conventional probe measurements, are used to capture the 3D velocity field upstream of the impeller.

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