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Background oriented schlieren (BOS) and particle image velocimetry (PIV) applied for transonic turbine blade investigations

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ABSTRACT

Turbine blade models equipped with film and trailing edge coolant ejection were investigated in the plane cascade wind tunnel of the DLR in Göttingen. The instantaneous velocity fields were quantitatively investigated by particle image velocimetry (PIV), and the density gradient fields were visualized by conventional schlieren photos, but also quantitatively determined by background oriented schlieren (BOS). The PIV measurements, but also the BOS measurements of the density gradient fields gave an insight into effects as for example the change of the compression shock strength depending on the coolant flow rate. The BOS technique can be seen as an simplified version of the well known speckle density photography and offers special advantages concerning the applicability. The experimental procedure and the results will be presented focusing on the metrological aspects. A numerical simulation of the flow velocity field and a numerically derived density gradient distribution based on computed light deflections will serve for a qualitative comparison with the optically obtained test data.

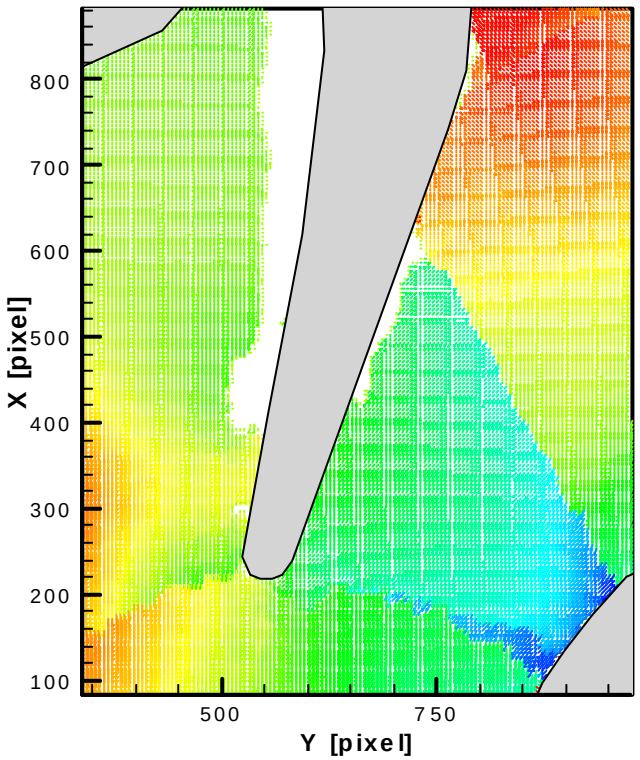

Fig. 1: Density gradients in a transonic flow (Ma_{2is} = 1.2) in a plane turbine cascade wind tunnel determined by the background oriented schlieren (BOS) method. The gradient components $d\rho/dx$ and $d\rho/dy$ are plotted as vectors, which are color coded with the gradient magnitude. (Flow coming from above)