Local density information obtained by means of the Background Oriented Schlieren (BOS) method

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ABSTRACT

The fairly new measurement system BOS is providing promising results by allowing the visualisation of qualitative density gradients as presented by Richard *et al* (2000). Because of this and the very easy set up, a further development towards a quantitative density measurement technique is requested.

Absolute density measurement systems are rare, especially for fluids, which are only accessible optically. This paper closes this gap by showing that it is possible to measure local density information by means of BOS for the specific application of a 2D jet. It is obvious that there are many other applications for this simple, quick and cheap density measurement technique, especially in view of the fact that many other measurement techniques are only qualitative.

The underlying principle is to measure the distribution of the refractive indices in the flow by evaluating the displacement of a background pattern. Similarly to speckle photography, which is a root of BOS, the light ray deflection due to density gradients within the observed volume is evaluated. By cross correlating the captured images of the background pattern with and without flow, the displacement of the pattern can be obtained. These displacements can be related to local refractive indices and further on to information about the local density values of the flow field.

An experiment is described to present the feasibility of BOS to measure local density information. A slit nozzle blowing an air / helium mixture was investigated by BOS and Catharometry. Comparing the obtained results and taking the Catharometry measurement as the reference, the accuracy of the density information provided by BOS can be evaluated (fig.1).

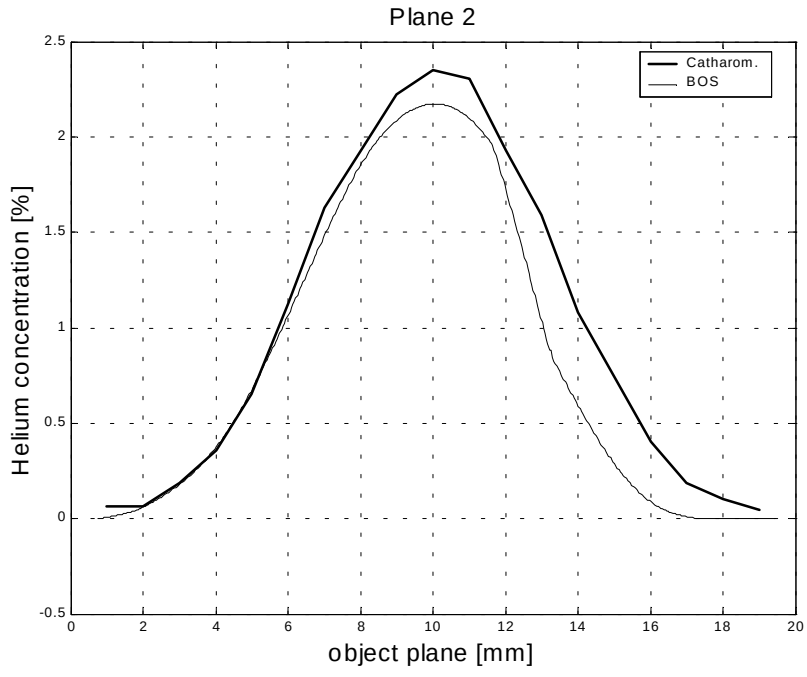

Figure 1: The helium distribution in a plane 33mm above the nozzle obtained by Catharometry and BOS