INVESTIGATION OF BACKGROUND ORIENTED SCHLIEREN (BOS) TOWARDS A QUANTITATIVE DENSITY MEASUREMENT SYSTEM

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The two years old measurement system BOS is using the change of the optical properties of a fluid due to temperature, concentration or compressibility effects. This measurement system is –up to now- only used as a visualisation tool, even if it provides detailed information about the location and the direction of the density gradients. However, because of the simple set up (only consisting of a camera and an appropriate background) and the results obtained by the first qualitative experiments, this technique is really promising and worth to develop it further on towards a quantitative measurement system.

Starting from the known facts about geometrical optics and light ray deviation this work tries to derive the governing theory underlying BOS as complete as possible. Out of this theory, general rules for BOS measurements were developed, which enable to choose the parameters of a set up in order to obtain best possible results

The derived relations were proved by an experiment, which was carried forward. The investigation of a quasi 2D slit nozzle extending a mixture of air and helium by BOS and catharometry allows a comparison of the results.

By applying the derived relations, it was possible to determine helium concentrations by BOS, which are matching up to a difference of 30% with the results obtained by catharometry that was taken as a reference.

The differences between the BOS and the catharometry results are explained by the insufficient spatial resolution of the used set up. It was possible to determine the limitations of the measurement system as there are:

- spatial resolution
- non parallel light

However, the investigated slit nozzle was a severe test case if one considers the nozzle width as to be 1 mm and the interrogation area size to be 2.2mm. By investigating smaller gradients the obtained results would probably have fitted better the reality. This and the influence of the blur need to be investigated in the future.

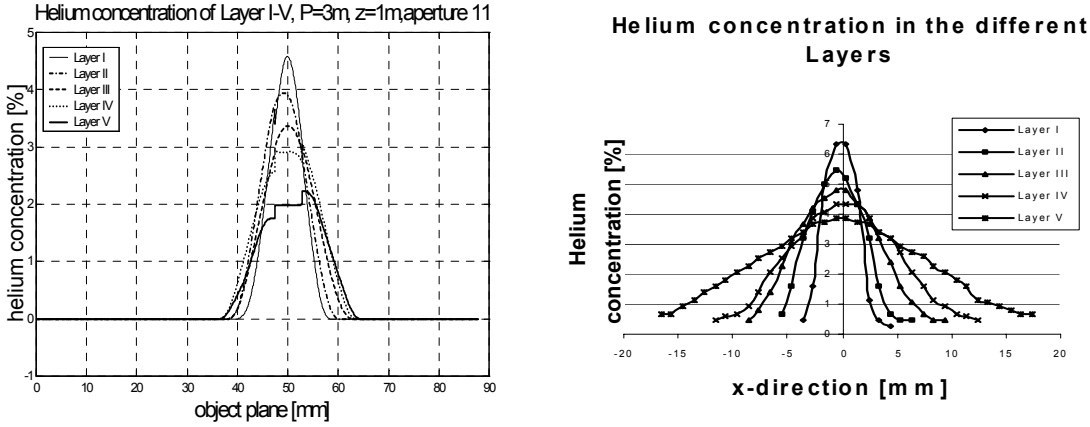

Figure 1: Helium concentrations measured by BOS (left) and catharometry (right)