EXPERIMENTAL CHARACTERIZATION OF FREESTREAM DISTURBANCE LEVEL OF THE VKI H3 WIND TUNNEL

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This project is carried out in the framework of the supersonic and hypersonic boundary layer transition activities. The objective of the project is to carry out an investigation of the free-stream disturbance environment of the VKI-H3 test-section jet by means of classical intrusive measurements techniques such as hot-wire anemometry and static/total pressure probes, provided with high frequency response pressure transducers.

Another important objective is the implementation of this technique for this facility and an evaluation of their effectiveness in measuring the unsteady properties of the flow.

The assessment of the flow quality of a wind tunnel is a key issue, especially in transition to turbulence studies. Indeed free-stream disturbances and flow quantities fluctuations have a dominant role on boundary layer stability and transition, especially at high speeds.
The implementation of the above mentioned techniques is studied and its application to the VKI H3 Wind Tunnel is carried out, including the development of suitable calibration techniques for the different probes in the present facility.

The disturbance measurement is carried out on the centerline of the VKI H3 wind tunnel Freestream jet. The tests are carried out at different free-stream conditions, including the standard VKI H3 conditions (p_0 = 11,21, 31 bar). Statistical and spectral analyses are compared to the data available in literature for other hypersonic wind tunnels, working at similar conditions for Mach and Reynolds number.
A data reduction technique coupling the different flow quantity fluctuations is developed: this technique allows the computation of all the fluctuations of the flow quantities from the ones that are directly measurable through the above-mentioned instrumentation. The validity of some physical hypotheses on the flow (such as the *Strong Reynolds Analogy*) can be verified. Moreover, a modal analysis of the turbulence quantities can be carried out, in order to better understand the physical meaning and the origin of the disturbances.

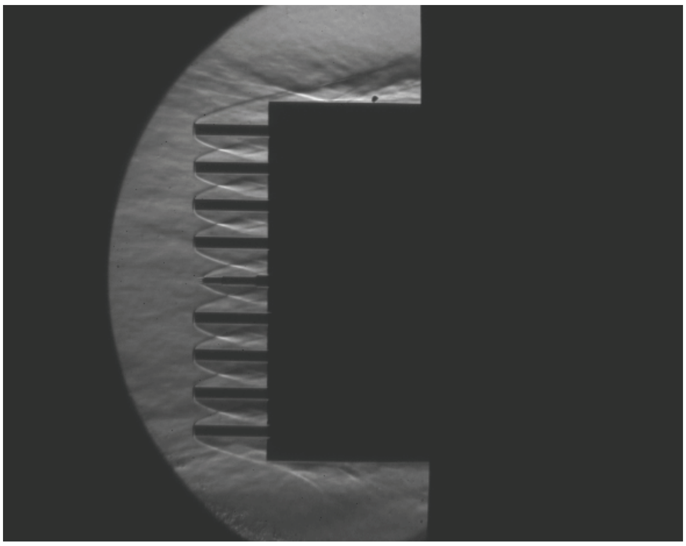

Figure 1: Schlieren Visualization of the Support Used for the Measurement, inside the VKI H3 freestream jet