THE MEASUREMENT OF TURBULENCE WITH FAST RESPONSE PRESSURE PROBES FOR TURBOMACHINERY APPLICATIONS

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The understanding of the unsteady flow that characterizes high speed turbomachinery is one of the keys to better improve and predict the aero-thermal performance and structural integrity of their design. Additionally to Hot-Wire Anemometry and Laser Doppler Anemometry techniques, a more recent technique has arise in the last 20 years as a mean to study and characterize unsteady flows: the Fast Response Aerodynamic Pressure Probes (FRAP). These types of probes make use of piezo-resistive sensors.

The aim of this work is to test the probe AP1-C25 developed at Von Karman Institute as a measurement tool to characterize turbulent flows. In order to do this, transversal measurements are performed in different areas of an air free jet: core and shear region. In same conditions hot-wire measurements were equally done in order to have a reference measurements. This kind of tests can highlight, in a flow with less complexity than for instance the flow existing behind a rotor, the differences between these two techniques.

Additionally, the tests were done at two different Mach number: Ma=0.3 and 0.5. The total pressure fluctuations are computed and compared with a correlation given by *"Wallace"* in previous studies with this type of fast response pressure sensors.

Once the free jet, C-4 facility, is a non-controlled temperature facility, the effect of the temperature change during the tests is taken in account, being the fast response probe full calibrated in pressure and temperature and the hot-wire compensated for non-constant temperature flows.

The results show that the flow temperature effect is an important issue to perform correct measurements, and even with a full pressure and temperature calibration map, the mean velocity presents some deviation due to temperature effects. However the fluctuations pressure and velocity values given by both techniques has shown a good qualitative accordance, with the FRAP being less sensitive than the hotwire.

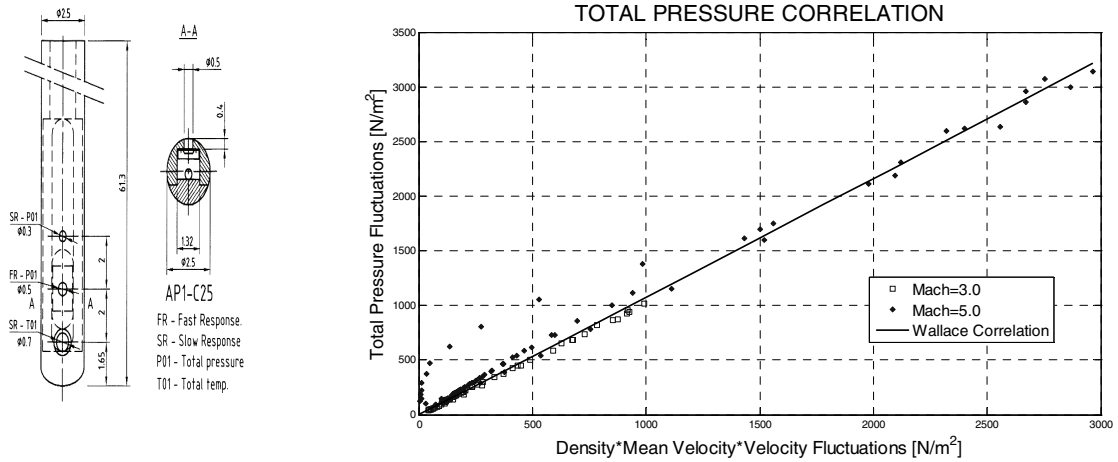

Figure 1: Probe AP1-C25 (left); Experimental data points in the free jet and Wallace Correlation (right)