ACOUSTIC INFLUENCE ON TRANSITION IN THE VKI H3 HYPERSONIC WIND TUNNEL

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It has been well known that boundary-layer transition measured in wind tunnels occurs at lower Reynolds numbers compared to flight tests at supersonic speeds. This early transition in wind tunnels is due to acoustic noise radiated from the turbulent boundary layers of the nozzle wall. To better understand transitional flow test results in the Mach 6 Hypersonic H3 Wind Tunnel Facility of the von Karman Institute, an investigation of the influence of acoustic radiation on transition has been undertaken.

The aims of this work have been to estimate dominant acoustic frequencies in the facility, to localize transition and to control acoustic power levels. The main approach has been to use a microphone, located in different positions, also flush mounted in a flat plate model, and to compare the results with previous infrared camera measurements and Schlieren photos, in order to evaluate acoustic signals in laminar, turbulent and transitional cases.

The first activity was to characterize the noise level in the wind tunnel, to better understand transitional flow test results. The location of the microphone was varied and the signal was recorded during different operating conditions of the wind tunnel. A second effort involved the investigation of acoustically induced transition. Isolated and distributed roughness were glued on the model (the flat plate) and its effect was measured by means of the microphone. This was done to assess the boundary layer receptivity. An acoustic means for inducing transition was tested; the idea was to install in the test section a device (Helmholtz resonator) in order to generate an appropriate acoustical signal to induce transition in a laminar boundary layer. Fourier spectra of the microphone signature were performed to provide the amplitude and frequency of the noise during the test.

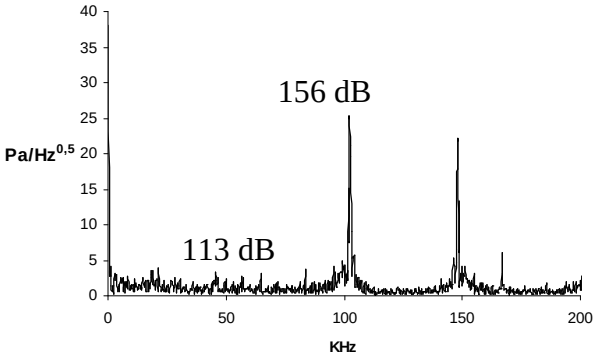

Figure1: Fourier spectrum of the smooth condition test

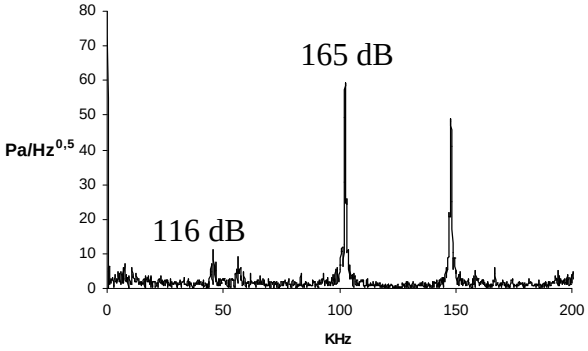

Figure 2: Fourier spectrum of the test with isolated roughness