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High Speed Differential Interferometry Used for Analyzing Aerooptic Aberrations

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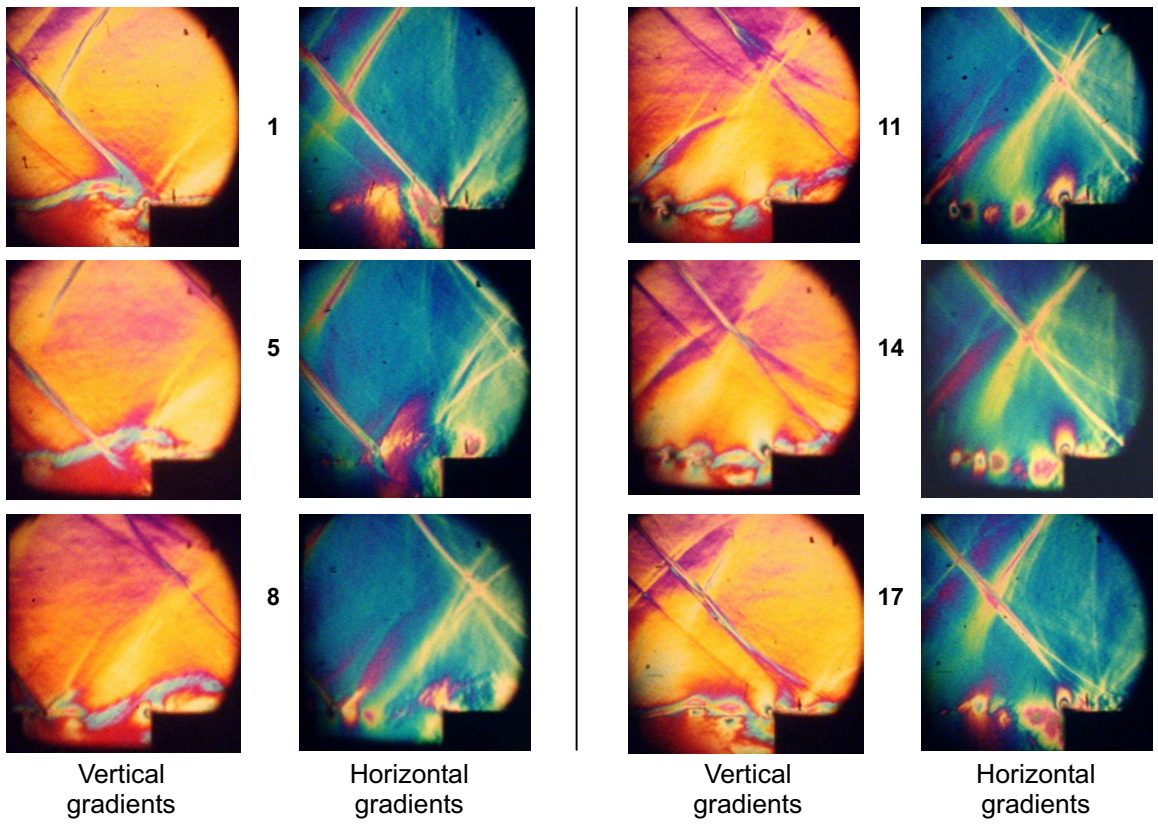

Fig. 1. High speed differential interferograms along the horizontal axis – ΔT = 28.5 μs – Mach 0.73.

High speed differential interferometry based on Wollaston prisms and polarized white light is used to analyze aerooptic aberrations induced by the flow above a cavity. The aim is both to propose an aerooptic statistical modeling validated by experiments and to constitute a full experimental data base, integrating aerodynamic data for the flow computation and optic aberrations data.

Two optical set ups have been defined to observe the gradients of refractive index of the flow along two perpendicular directions. Along the horizontal axis, high speed interferograms show the phenomenology of the coupling between the vortical structures of the mixing layer and the compression waves which move upstream the flow and are reflected by the upper floor of the test section. Figure 1 shows six high speed successive interferograms visualizing the horizontal and vertical gradients for a Mach number of 0.73. Each couple of interferograms is taken at the same phase of the pressure fluctuation and they cover one period of the phenomena. One see two different states of the mixing layer. On interferograms noted 1, 5 and 8, the interaction of the reflected waves with the mixing layer induce a disorganization of the vortices. On Interferograms 11, 14 and 17, one can clearly visualize the vortices in formation phase. However, these phenomena, observed with a confined flow configuration, are probably not representative of what should be observed in real flight conditions. Along the vertical axis, the analysis of interferograms has yielded the spatial distribution of the wavefront gradient and its evolution in time. A statistical analysis of the longitudinal and transverse refractive index gradients has been made from a sequence of 60 samples. These measurements have to be compared to measurements obtained with the Shack-Hartman technique.