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Portfolio Paper

Analysis of Wake Flow around a Circular Cylinder by Real-Time Color Denisyuk Holographic Interferometry

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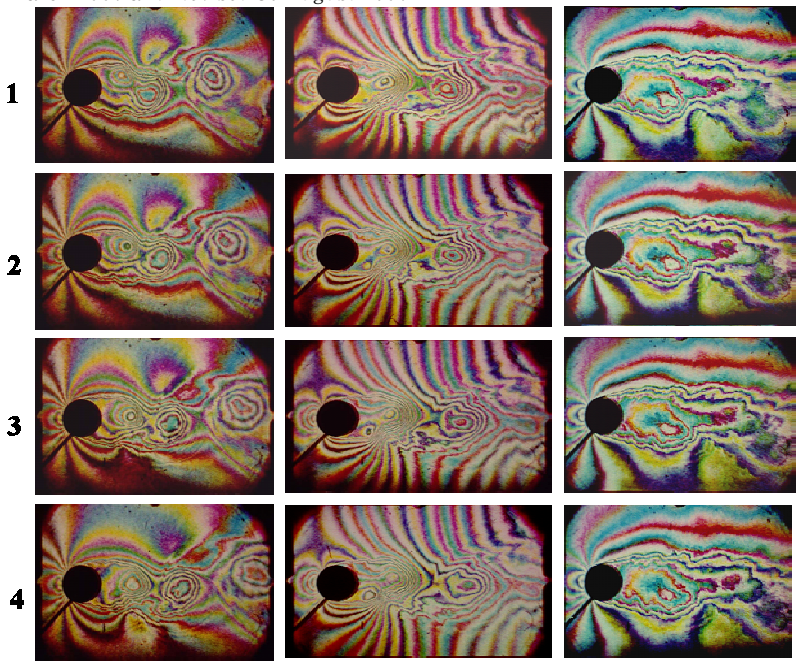

Fig. 1. High speed holographic interferograms –Δt = 54 μs – Mach 0.45.

ONERA and DGA have shown the feasibility of real-time color Denisyuk holographic interferometry for analyzing high speed flows. In this technique, the light source used behind the interferometer is constituted by a krypton laser (λ_1 = 647 nm), a green line (λ_2 = 532 nm) and a blue line (λ_2 = 457 nm) from two diode pump solid state lasers. An acousto optical cell diffracts the unwanted lines of the argon and krypton laser in the light mask and does not deviate the three wanted patterns that are generated by three appropriate frequencies. A spatial filter and an achromatic lens are used to illuminate the hologram with a parallel light beam of 120 mm in diameter. A flat mirror located just behind the test section containing the object returns the three beams on the hologram. Hologram is illuminated on the two sides by the three divergent reference beams and the three convergent measurement waves. In this setup, a beam splitter polarizing cube is inserted between the spatial filter and the hologram. The half quarter plate turns the waves polarization twice so that, when the rays are returning, the beam splitter cube returns the rays towards the screen. Contrary to the optical setup developed for the analysis of the 2D flows, in the one proposed for 3D flows, reflection holograms are used. In the case of reflection holograms, the diffraction efficiency is strongly influenced by the variations in the gelatin thickness produced during the holograms treatment. Solutions are proposed to control the gelatin shrinkage and the first results obtained in wind tunnel are shown in one sight of view. In this study, the diffraction efficiency of the hologram is near 50 % for each line. High speed interferograms of unsteady wake flow around a circular cylinder have been obtained in narrowed fringes and uniform background at Mach 0.45. Here, contrary to differential interferometry which visualizes the gradient of the gas density, each color directly visualizes a value of gas density itself.