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The Fringe Reading Facility at the
Max-Planck-Institut für Strömungsforschung

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1) Optical equipment

A Mach-Zehnder-interferometer is used for optical flow measurements in a transonic wind tunnel. The duct width is 100 mm. The light source is a spark chamber (Impulsphysik). High speed recordings can be made with a rotating drum camera at a frame rate of 10 kHz or with a rotating prism camera (Fastax) at frequencies up to 8 kHz. Periodic processes are frequently investigated by taking single pictures triggered by a controlling computer at a certain phase.

Holographic interferograms are reconstructed by illumination with a He-Ne-Laser and viewed by a video camera through wide angle optics. This setup has been used for investigating industrial double-exposure holograms of truck tires in order to develop methods of automatic recognition of certain manufacturing faults.

A Zeiss microscope used in conjunction with a Mirau interference device has been used for studying membrane oscillations.

2) Computer hardware (Fig.1)

Automatic input is achieved by a transient recorder (Biomation S8100) digitizing the output of a TV-camera and transferring the digitized data to a PDP11-34. Generally, a resolution of 512x512 pixels with 8 bit gray levels is used.

A graphic tablet and a graphic terminal are connected to the system to provide manual input.

Preprocessing of the images and fringe extraction are done with the PDP11-34.

Connections exist to a VAX11-750 which is used for more complex and time-consuming routines like fringe numbering or polynomial approximation and also to an array processor (Floating Point Systems AP120) used for FFT routines.

An image processing system (Imaging Technologies IP512) will partially replace the PDP11-34 and speed up image preprocessing.

The image processing routines mentioned above are described in refs. 1,2.

3) Current activities and plans

For some time the interest of our group has centered around sequences of interferograms showing the interaction of vortices with a profile and subsequent emission of sound generated by this process. Figure 2 shows two examples of this process; the experiment was performed with a NACA 0012 profile at Mach 0.8. These studies are of interest with respect to investigating the causes of helicopter rotor noise (ref. 3).

For better time resolution a higher photographic frequency will be needed. This problem may be solved by using a LED light source with a frequency up to 100 kHz as compared with the 8-10 kHz achieved with the spark lamp used until now.

Furthermore, evaluation is rendered somewhat difficult by the complicated structure of the interferograms, for example by the appearance of shock fronts. At present, routines for automatic recognition of vortices and shock fronts are being developed. Ultimately, the objective will be the extraction of quantitative data which relate to the emission of noise.

References:

1. Becker, F.; Meier, G.E.A.; Wegner, H.: Automatic Evaluation of Interferograms, SPIE Proceedings Vol.359 (1982)
2. Becker, F.: Zur automatischen Auswertung von Interferogrammen, Mitt. MPI für Strömungsforschung, Göttingen Nr.74 (1982)
3. Meier, G.E.A.; Timm, R.; Becker, F.: Initial Experiments on Profile Vortex Interaction, Berichte MPI für Strömungsforschung, Göttingen Nr.6 (1983)

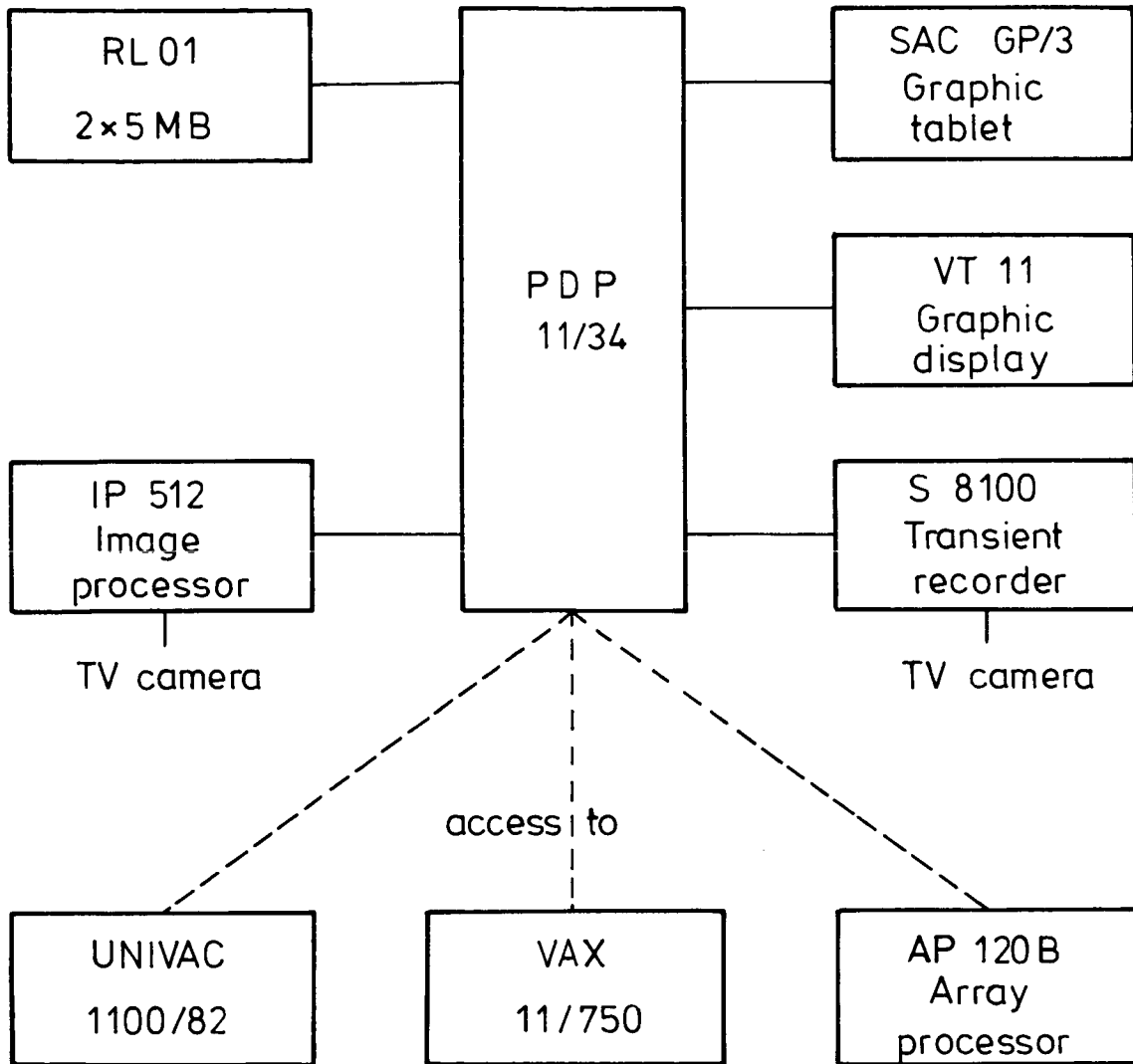


Figure 1

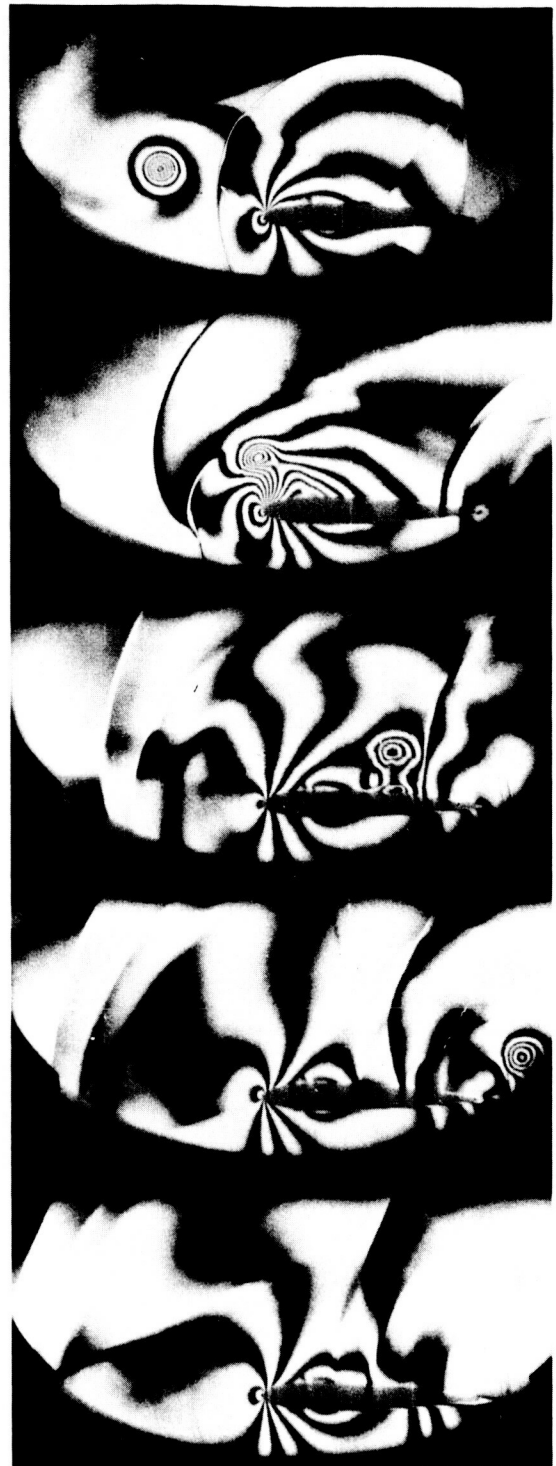
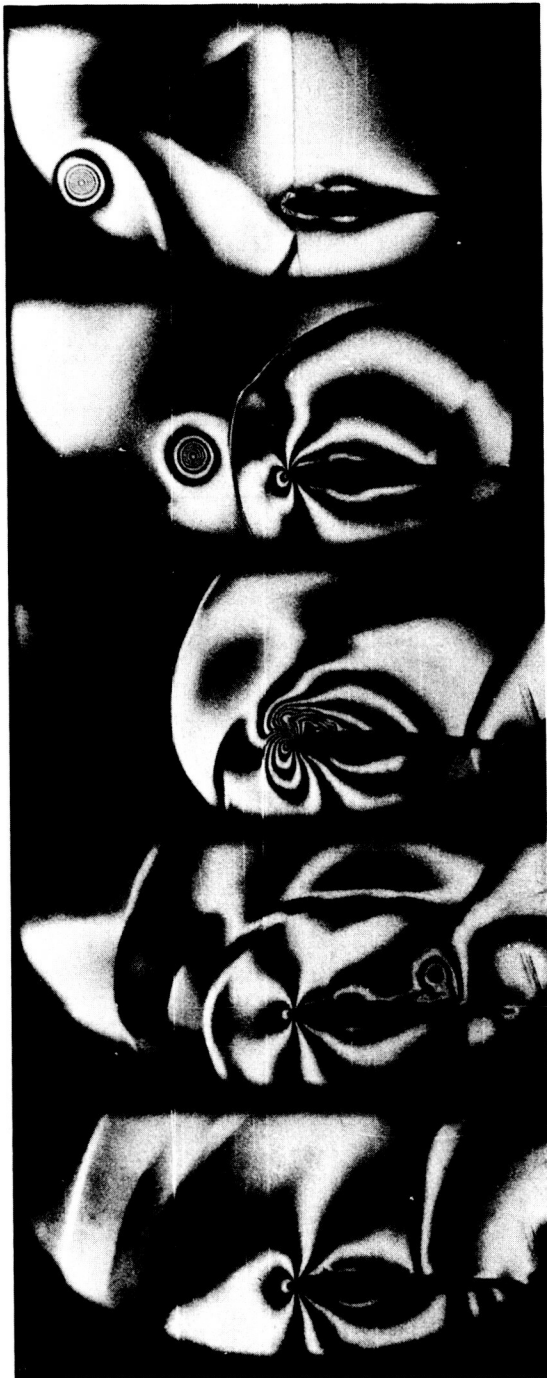


Figure 2

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