25 years of PIV development for application in aeronautical test facilities

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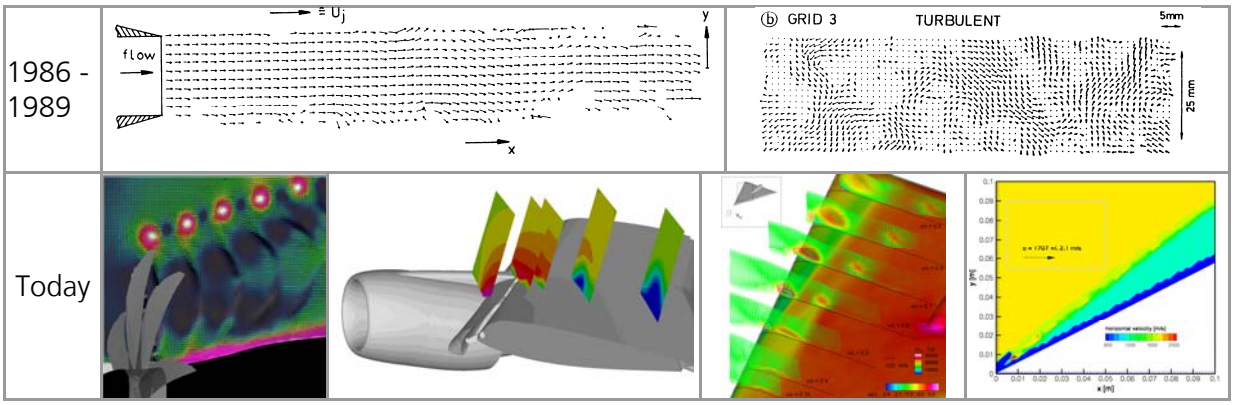
In summer 1984 teams of the University of Oldenburg and DLR carried out measurements of instantaneous flow field by means of Particle Image Velocimetry for the first time in a wind tunnel of DLR Göttingen. In those days the recording of the PIV images had to be done photographically. Also, the evaluation of the recordings to obtain the displacement of the images of the tracer particles, added to the flow, had to be performed optically. A few months later DLR had the first double oscillator Nd:YAG laser at its disposal and started the development of a PIV system applicable for aerodynamic research in large industrial wind tunnels. Around 1995 a major breakthrough in the development of PIV, which has been a prerequisite to bring this technique out of the laboratory and into use at research organizations for applications of relevance to industry, has been made. Then, digital video cameras, allowing capturing the two frames of a PIV recording within a short time interval and with full spatial resolution and the necessary cross correlation evaluation algorithms became available. In the following decade the PIV technique has been widely spread and differentiated into many distinct applications ranging from micro flows to combustion and supersonic flows, both for research and industrial needs. This was made possible mainly due to further technological progress in video techniques, lasers and the development of sophisticated evaluation algorithms.

The most important developments and achievements required to perform successful application of PIV in aeronautical test facilities of industrial interest have been: powerful seeding devices, robust double oscillator Nd:YAG lasers, hard- and software for PIV allowing to utilize cross correlation for evaluation, Gaussian peak fit, sensitive (cooled) CCD cameras, and continuous improvement of spatial and temporal resolution of light sources and cameras. The acceptance of the PIV technique by industry has been facilitated through the support of European projects such as EUROPIV, EUROWAKE, EUROLIFT, AWIATOR etc. where it has been possible to demonstrate the additional and new knowledge about the behavior of flow structures in complex unsteady flow fields (separated flows, tip vortices, wake vortices, boundary layers, gap flows etc.) as obtainable by application of PIV.

Nowadays the PIV technique is considered a 'validated tool' by the aeronautical industry and used in large industrial wind tunnels to support the design of new aircraft. Within this context PIV flow field data are increasingly used for validation of results of numerical calculations.



For further details see of results of PIV team of the Department of Experimental Methods:
http://www.dlr.de/as/en/desktopdefault.aspx/tabid-183