

EARLY PIV DEVELOPMENTS AT THE VON KARMAN INSTITUTE

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INTRODUCTION

Roland Meynart introduced Particle Image Velocimetry at the von Karman Institute where he started in 1981 to perform part of his pioneering work within his PhD research. After the end of his thesis, the VKI continued the development and applied this technique to most domains of fluid dynamics.

SILVER PROCESS: 1981 – 1989

This paper describes the work done at the VKI between 1984 and 1997. It first presents work done with silver processes and development of Young's fringe processing, then the implementation of a moving mirror by V. Gauthier, a post-graduate student, in 1986 to resolve directional ambiguity and increase velocity dynamics. Also, in 1986, another student, J.F. de Almeida Dias Delgado performed the world first stereoscopic PIV measurements using photo cameras. The same year, C.S. Moraitis performed measurements in a small supersonic nozzle and started to develop holographic processing of young's fringes. In 1987, N. Paone performed the world first PIV measurements in a transparent pump using a CW laser pulsed by a combination of rotating shutter and moving blade. In 1988, the VKI organized the first meeting devoted to PIV in the form of a Lecture Series with courses given by the few experts of the time and a series of paper presentations given by the researchers who were active in the early developments of PIV at this time. In 1989, R. Obertacke and P. Corieri performed PIV measurements in a model of a lung bifurcation using the early silver technique.

DIGITAL PIV: 1990 - 1997

The first cross-correlations of digital images were made at the same time by N. Selfslagh and tested on the lung test in 1990 by P. Corieri. Since the computers were still far too slow, correlations were made on binarized images issued from video framing camera recordings using Logical Functions and moving windows were already applied. PC based array processors were also applied to improve processing time. In 1993, the silver technique was applied to measurements in a compressor facility by D. Tisserant. After several developments, in 1995 the first full cross-correlation using FFT and sub-pixel interpolation was developed by J-B Moens who also converted a video camera into a dual frame recording tool. The era of digital PIV was started at the VKI and numerous applications were immediately performed: natural convection on a heated wire, surface velocity of wavy liquid films and micro-PIV to measure the velocity field in the nip between two roll coating cylinders, using a microscope. At the same time, some people were still convinced of the power of holography and E. Fabry developed a stereoscopic technique based on holographic recording to perform measurements in turbomachines. Time resolved measurements were started in 1996 by H. Richard in a water tunnel using a CW laser with a camcorder and by A.H. Rike in a wind tunnel using a CW laser with a High Speed Video camera. 1997 was the end of the early developments with the work of F. Scarano who developed an advanced algorithm for processing PIV images that used window displacement and distortion with an iterative multigrid technique. This type of algorithm soon became the standard of most processing tools.

CONCLUSION

In conclusion, we can say that an important work has been performed at the VKI in the early days of PIV. A good dissemination of knowledge has been ensured through the multiple Post-graduate students who worked in the field and also by the successive Lecture Series, the first one being organized in 1988. The VKI also applied very early the PIV in a wide range of applications.