APPLICATION OF SUPER RESOLUTION PIV TO SIMULTANEOUS VELOCITY AND CONCENTRATION MEASUREMENTS

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In many fields of fluid dynamics, simultaneous planar velocity and concentration measurements form a desirable tool to achieve the understanding of the studied phenomena.

The main purpose of this project was to perform an experimental validation of the Super Resolution Particle Image Velocimetry (SRPIV) developed at the VKI. This technique combines PIV and PTV: PIV provides the velocity field through cross-correlation and PTV allows the measurement of tracer concentration using its particle identification capability. The technique has one advantage over others available, the fact that it relies on one camera/one laser/ one tracer to perform both measurements. The measurement of concentration has a non-linear behavior but correction procedures are used once the particles image diameter and other experimental parameters are determined.

The validation procedure consisted of measurements taken in the near field (0-9D downstream) of a turbulent axisymmetric jet (Re_D=15000) and comparing the results with catharometry measurements and reference works. A new setup was designed to hold both measurement techniques requirements and to ensure that the comparison of results is correct.

One of the conclusions from the validation procedure is the need to take special care in the configuration of the optical system for it defines the particles image diameter. The diameter of the images is important for SRPIV as it determines the particle overlap, useful range of concentration and establishes the correction for the non linearity of the tool.

Another concentration measurement approach was evaluated: the Discrete Light Scattering Technique DLST). Based in the LST, it measures the light intensity scattered by the particles. The difference is that it uses images with lower tracer concentration, allowing the use of PIV techniques to determine the velocity field. Good results support the application of the DLST technique in flows with low seeding concentration. For the smaller window sizes, the instantaneous random error cannot be neglected, but the linear response and independence of analytical correction procedures are two advantages over the SRPIV.

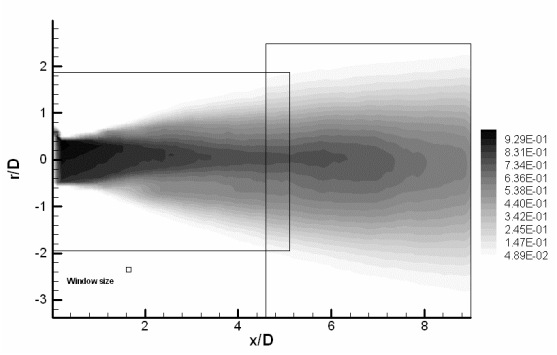

Figure 1: The concentration field determined by SRPIV

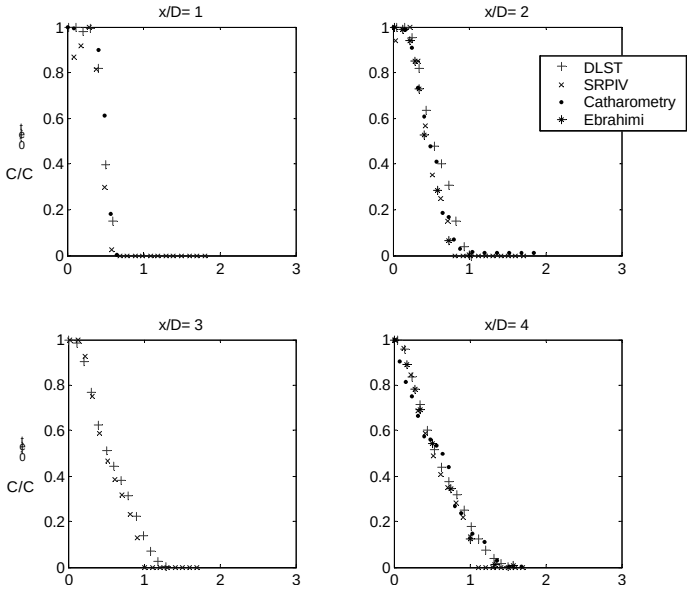

Figure 2: Radial concentration profiles at downstream positions obtained by different techniques