

4D-PIV advances to visualize sound generation by airflows

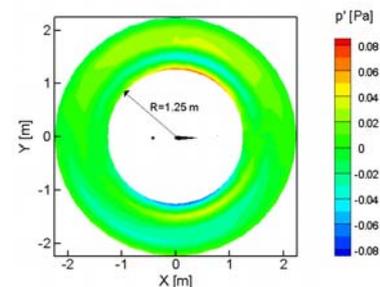
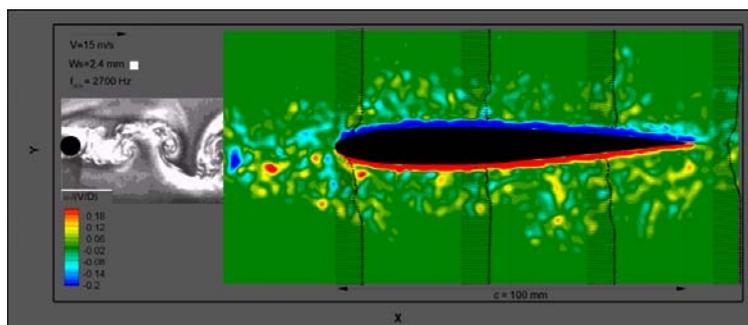
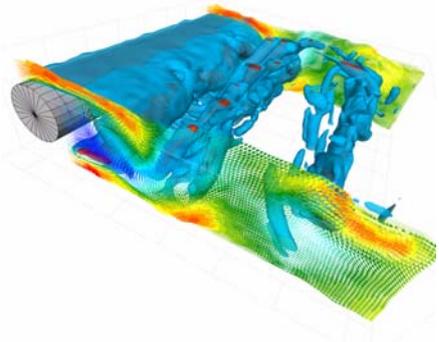
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The recent developments of the Tomographic Particle Image Velocimetry technique¹ and data reduction techniques for non-intrusive pressure field characterization method² opens unforeseen perspectives in the area of unsteady flow diagnostics and experimental aero-acoustics. As a result of this work it is now possible not only to quantify complex flows in their three-dimensional structure³, but also to extract quantities such as the instantaneous fluid flow pressure field⁴.

The current research is directed towards an innovative approach to experimental aero-acoustics making use of time-resolved Tomographic-PIV experiments to fully describe and quantify the flow pattern around aircraft critical components and the related acoustic source term at its origin. The use of aeroacoustic analogies in conjunction with PIV data will provide the basis for the estimation of sound source identification and noise emissions.

The *flow-visualization inspired aeroacoustics approach* is introduced and its working principles are discussed with a first application of time-resolved planar PIV to the rod-airfoil problem, a benchmark for vortex-structure interaction noise⁵. Also highlights from current activities on 3D experiments on jet-noise will be given.



¹ Elsinga GE, Wieneke B, Scarano F and van Oudheusden BW (2006) “Tomographic particle image velocimetry”, *Exp. Fluids*, 41, 933-947

² Liu X and Katz J (2006) “Instantaneous pressure and material acceleration measurements using a four-exposure PIV system”, *Exp. Fluids*, 41, 227-240

³ Scarano F and Poelma C (2009) “Three-dimensional vorticity patterns of cylinder wakes”, *Exp. Fluids*, 47, 69-83

⁴ de Kat R, van Oudheusden BW and Scarano F (2008) “Instantaneous planar pressure field determination around a square-section cylinder based on time-resolved stereo-PIV” *14th Int Symp Appl. Laser Tech. Fluid Mech.*, Lisbon, PT

⁵ Lorenzoni V, Tuinstra M, Moore P and Scarano F (2009) “On the Use of Time-Resolved PIV for an Aeroacoustic Investigation of Rod-Airfoil Noise”, *J. Sound Vibr.* (to appear)