PARTICLE IMAGE VELOCIMETRY IN A SUPERSONIC AIR EJECTOR

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ABSTRACT: Ejectors are devices used to convert pressure energy into kinetic energy. They are usually made of two convergent-divergent coaxial nozzles. The primary nozzle delivers supersonic jet which aspires and entrains a secondary flow along the mixing tube of the secondary nozzle. Supersonic ejectors are employed in many applications: vacuum pump, ejecto-compressor fluids separator, jet propulsion thrust augmentation … These devices involve very complex phenomena (interaction between supersonic and subsonic flows, shocks, mixing, instabilities possible condensation …) which strongly affect their performance. A detailed study of the flow, by measurement of local pressure or velocity for example, is sometimes considered but proves very delicate to implement in particular in the case of supersonic flows with shocks. The visualization of the flow represents an interesting alternative to these measurement techniques by giving access to very preciouse information as for the nature of the flow within the ejectors and the comprehension of the physical phenomena encountered (Bouhanguel et al., 2011). Unfortunately, the visualization methods used successfully until now (laser tomography, Schlieren) in these systems are primarily qualitative techniques. Some attempts at quantitative flow visualization by particle image velocimetry have been carried out in quite specific applications and with mitigated results due to the complicated conditions of investigation (high flow velocity, quality of flow seeding). The objective of this paper is to present the first results of PIV measurements obtained within our laboratory on an air ejector. Several ejector operating conditions (with or without secondary flow entrainment) are studied. Different flow seeding methods (natural seeding by condensation micro droplets, artificial tracers added into the secondary flow) are tested. The velocity fields obtained are compared with CFD simulations of the flow (Figure 1) and allow the rigorous validation of numerical models.

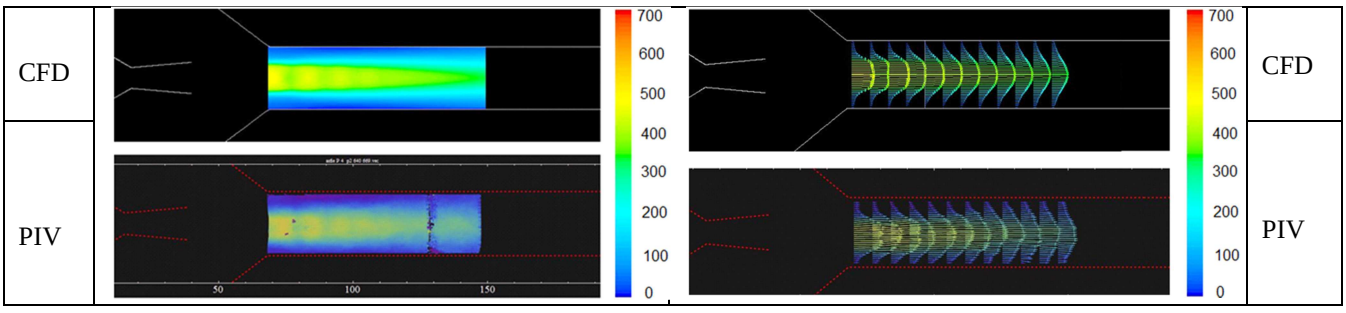

Fig. 1 Iso-velocity contour (left) and velocity vector representation (right)

References

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