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THREE DIMENSIONAL DYNAMICS IN SWIRLING IMPINGING JETS

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ABSTRACT:

The influence of the swirl number on the flow field and on the vortex dynamics of a multichannel swirling impinging jet is experimentally analyzed. This investigation is concerned with jets issued from swirling nozzles based on helical inserts, which are easily applicable in an industrial environment[1]. Ianiro and Cardone[1] measurements found an interesting heat transfer behavior for the multichannel swirling impinging jets at low nozzle-to-plate distance, thus the present investigation is conducted at a fixed value of the Reynolds number (*Re* equal to 10,000), for five values of the swirl number (*S* equal to 0, 0.2, 0.4, 0.6 and 0.8) and at nozzle-to-plate distance equal to 2 diameters. Results obtained with swirling impinging jets are also compared with those obtained with a circular impinging jet in the same testing conditions. Measurement are performed with time-resolved tomographic particle image velocimetry[2] in a water jet facility on a volume on the impinged plate having size of 1.2x4x4 nozzle diameters. The obtained experimental data (both instantaneous and statistics flow fields) supply information on the behavior of circular jets, multichannel jets, weak swirl jets and strong swirl jets. The measurement of the instantaneous velocity vector field over a three-dimensional domain enables the evaluation of the complete velocity gradient tensor and the associated quantities, such as the vorticity vector and thus to study and describe vortex dynamics. With reference to the literature, the dependence of heat transfer on the flow field is also described.

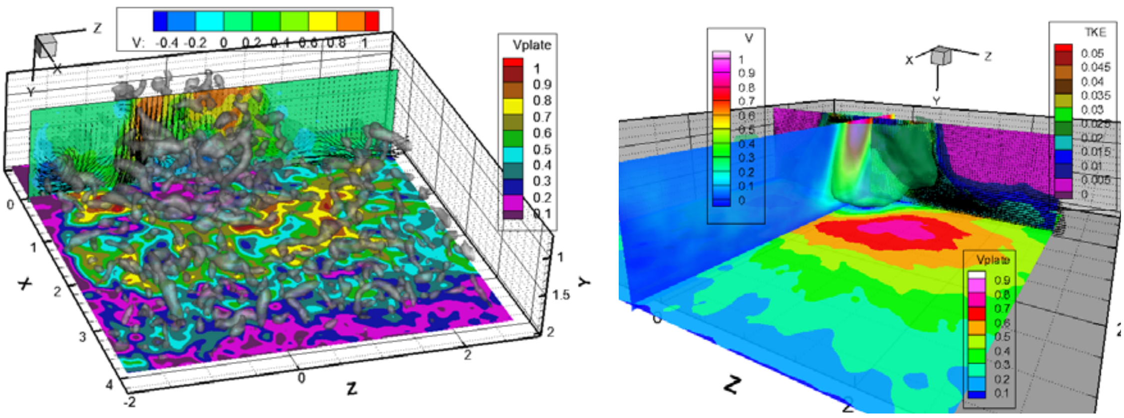

Fig. 1 Impinging jet at S = 0.4: Instantaneous flow fields: contour of axial velocity on the plane with velocity vectors X= 0, contour of velocity on the plane at 0.04 diameters from the plate, and iso-sourface of Q = 1.5 in translucent (left), Flow field statistics (right)

References

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