

Flow patterns in a round jet impinging at short nozzle-to-plate distance

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Abstract A round jet impinging on a flat plate is investigated with time-resolved tomographic PIV. The jet is issued from a short pipe at Reynolds number $Re = 10,000$ and impinges normally to a plate placed at a distance of two diameters downstream of the nozzle exit. The evolution of the instantaneous vortical topology is visualized with the Q criterion.

Ring vortices form within the shear layer of the jet and are convected towards the wall. Approaching the wall, the ring vortices are stretched, show mutual interactions and later break into C shaped structures.

A secondary vortical feature characterized by vortex pairs oriented in the stream-wise direction also forms into the shear layer. Stream-wise vortex pairs are subsequently ingested into the preceding ring vortex during the translation phase and end up connecting couples of ring vortices; their formation and interaction is visualized. The stream-wise vortices are also found to promote local tilting and deformation of the ring vortices.

On the wall, local unsteady separation and flow reversal, due to the passage of the ring vortex, are observed at the onset of radial jet spreading: downstream, turbulent boundary layer development in the radial wall jets is observed in correspondence of the location of the C shaped structures.

Keywords: Impinging jets, Tomo-PIV, Ring vortices
