Tomographic PIV measurements of azimuthal modes in jets issuing from circular and chevron nozzles

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HIGHLIGHTS

• Flow dynamics in turbulent jet has been studied by time-resolved tomographic PIV system
• Spatial Fourier transform (FT) over azimuthal angle allowed quantitative analysis of energy in different azimuthal modes
• Proper orthogonal decomposition (POD) for the velocity fluctuations after FT provided 3D spatial shapes of the most energetic structures for different azimuthal modes, including spiral structures

ABSTRACT

The present work reports on measurements of the shape and dynamics of large-scale vortex structures in circular and chevron turbulent submerged jets by the volumetric particle image velocimetry technique. A tomographic PIV system was used for the measurements of 3D velocity fields with 2 kHz acquisition rate. The datasets of PIV velocity fields were analyzed by spatial FT over the azimuthal angle and POD.

By analyzing results of the decompositions it was concluded that for the chevron jet the turbulent kinetic energy of the axisymmetric mode \( m = 0 \), related with toroidal vortices in the mixing layer, was more than two times lower in comparison with the jet from the circular nozzle.