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Reconstructing dominant three-dimensional flow structures in the wakes of cylindrical bodies using planar velocity measurements[1]
CHRIS MORTON, SERHIY YARUSEVYCH, University of Waterloo — The flow over cylindrical bodies typically involves the periodic formation of spanwise vortices. Numerous experimental techniques have been employed in the past several decades for investigating the physical characteristics of wake vortices, e.g., surface pressure measurement with microphone arrays, velocity measurement with Laser Doppler Velocimetry (LDV) and Particle Image Velocimetry (PIV). More recently, direct numerical simulations and the advancements in volumetric measurement techniques have enabled quantitative investigation of the three-dimensional wake development. However, in the domain of physical experiments, planar velocity measurement systems still remain to be the mainstream tool. Thus, dominant three-dimensional flow features are commonly reconstructed by using phase-averaged planar measurements conducted at several planes, which requires a periodic reference signal related to flow development. The present investigation utilizes a novel approach for phase averaging 2D PIV data by extracting the reference signal via Proper Orthogonal Decomposition (POD) of the PIV data. The method is applied to investigate three-dimensional development of coherent structures in the wake of complex cylindrical geometries.

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