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Reconstruction of three-dimensional coherent structures in turbulent wakes using planar measurements[1] SERHIY YARUSEVYCH, CHRIS MORTON, University of Waterloo — The present study is focused on reconstructing the dynamics of dominant three-dimensional coherent structures in turbulent wakes of complex cylindrical geometries using time-resolved, planar Particle-Image-Velocimetry data. As a test case, the turbulent wake of a low aspect ratio dual step cylinder model is considered. The model consists of a large diameter cylinder (D) of low aspect ratio (L/D) attached to the mid-span of a small diameter cylinder (d). Experiments are performed in a water flume facility for Re_D =2100, D/d =2, and L/D =1. The investigated model produces cellular vortex shedding, with distinct variations in the average shedding frequency along the span of the model, and the associated complex vortex interactions. Time-resolved velocity measurements are acquired simultaneously in two mutually orthogonal planes at multiple planes along the span of the model. The technique involves conditional averaging of the planar results to produce three-dimensional reconstructions of wake topology for a given planar alignment of the dominant spanwise vortex filaments. This is achieved by identifying velocity fields matching a given flow-based template. The results demonstrate that the proposed technique can successfully reconstruct the dominant wake vortex interactions and can be extended to other flows where traditional phase-averaging approaches are not applicable.

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