Tomographic PIV measurements in the wakes of cylindrical bodies

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Many bluff body structures in engineering applications, e.g., off shore oil risers, suspension bridge cables, components of aircraft landing gears, etc., undergo vibrations when exposed to sufficient wind velocity. It is a well-documented result of flow-induced periodic loading on the structure from a phenomenon known as vortex shedding. Depending on the environmental conditions, this can be a source of unwanted noise pollution, and may lead to fatigue failure with potentially dire consequences. The majority of past investigations of the vortex shedding phenomenon have been completed for uniform cylindrical bodies, or cantilevered cylindrical bodies. Few investigations have considered the influence of a change in diameter of the structure. The present study aims to provide insight into the flow development past cylindrical structures with step discontinuities in diameter. The test geometry is a dual step cylinder, composed of a large diameter cylinder (D) of small aspect ratio (L/D) attached to the mid-span of a small diameter cylinder (d). The flow development is investigated for $ReD = 2100$, $0.5 \leq L/D \leq 3$, and $D/d = 2$. Experiments are completed a wind tunnel facility employing Tomographic Particle Image Velocimetry (Tomo-PIV). The results have shown that turbulent vortex shedding occurs in the wake of the dual step cylinder for all the cases investigated. However, wake topology and vortex dynamics are influenced significantly by the geometrical parameters of the model. The Tomo-PIV measurements confirm that the flow development in the small cylinder wake away from the large cylinder is similar to that expected for a uniform cylinder. The flow development in the large cylinder wake involves complex three-dimensional vortex deformations and vortex splitting.