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Investigating three-dimensional wake topology of a low aspect ratio dual step cylinder with 2D PIV measurements CHRIS MORTON, SERHIY YARUSEVYCH, University of Waterloo — A dual step cylinder is 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 present work investigates the flow past dual step cylinders for $Re_D = 2100$, $0.2 \leq L/D \leq 3$, and $1.33 \leq D/d \leq 2.67$. Experiments are completed in a water flume facility employing Laser Doppler Velocimetry (LDV) and planar Particle Image Velocimetry (PIV), as well as hydrogen bubble flow visualization. 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, namely, L/D and D/d. A novel method is introduced for reconstructing salient features of the three-dimensional wake topology using phase-averaged 2D PIV measurements. The results show that flow development in the small cylinder wake away from the large cylinder is similar to that expected for a uniform cylinder of the same diameter. However, complex three-dimensional vortex deformations and splitting occur downstream of the large diameter cylinder. Four distinct flow regimes are identified based on changes in large cylinder wake development: (i) vortex shedding at a frequency lower than that expected for a uniform cylinder, (ii) irregular shedding, (iii) vortex shedding at a frequency higher than that for a uniform cylinder, and (iv) suppression of large cylinder vortex shedding.

Chris Morton
University of Waterloo

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