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Multi-time lag type PIV analysis of low Reynolds number inhalant flows[1] AARON TRUE, JOHN CRIMALDI, University of Colorado Boulder — Flows with high dynamic ranges of velocity can be challenging to measure with particle image velocimetry (PIV) since there is no single correlation timescale that completely optimizes particle displacements (correlation peak strength) everywhere. Inhalant flows, which draw fluid from a reservoir through an orifice and into a tube under the action of suction, exemplify this high dynamic range condition due to the rapid spatial attenuation of velocity with distance from the inhalant orifice. For these axisymmetric flows with relatively persistent spatiotemporal structure, the primary cause of correlation peak degradation is in-plane loss of particles due to extremely high (low) local displacements. Thus, during PIV analysis of these flows in an index of refraction-matched flow facility (borosilicate glass tubing matched with mineral oil), we developed and applied a simple multi-time lag type PIV postprocessing algorithm which cross-correlates image pairs across two different timescales optimized for some target low and high velocities. This yielded flow fields which were locally correlation-optimized throughout the entire experimental volume. For flows spanning three Reynolds numbers (1, 10, and 100) and three orifice heights (distance to a nearby bottom bed for an upward oriented tube, 0, 2, and 40 inhalant orifice diameters), complimentary numerical simulations showed that our multi-time lag type PIV analysis produced close agreement between measured and simulated flows throughout the experimental volume covering a high velocity dynamic range.

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