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Experimental investigation of entrainment processes of a turbulent jet DHIREN MISTRY, University of Cambridge, JAMES R. DAWSON, Norwegian University of Science and Technology — We implemented simultaneous, time-resolved, multi-scale-Particle Image Velocimetry (PIV) and Planar Laser-Induced Fluorescence (PLIF) to study entrainment processes in the far-field of a round, turbulent jet. The experiments were performed using water as the test medium and a passive dye with a Schmidt number $Sc \gg 1$ to identify the turbulent/non-turbulent (T/N-T) interface of the jet. The Reynolds number based on the nozzle exit is $Re = 25,300$ and is considerably higher than existing studies of entrainment in jets. Independent 2D PIV and PLIF measurements confirmed that the far-field flow characteristics agree well with the classical scaling laws of turbulent jets. We use the auto-correlation of entrainment velocity along the T/N-T interface to show that the interface is dominated by fluid motion of $\mathcal{O}(\lambda)$. We also show that there exists a balance between the mass flux across the interface calculated at the small-scales and the mass flux calculated at larger scales. The interface is more convoluted at smaller scales, which results in a larger interfacial surface area. The mass-flux balance therefore indicates that the entrainment velocity at the interface scales at a rate that is inversely proportional to the surface area.

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