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Investigation of the Entrainment Phenomenon Using a Scaling Approach[1] ARAVIND KISHORE, URMILA GHIA, Univ of Cincinnati — Air entrainment is a commonly observed phenomenon; we see it when filling a glass with water from a faucet, in the frothing of the ocean surface, in white water rapids, etc. The focus of our work is the numerical simulation of the entrainment phenomenon associated with laminar plunging jets. With increasing jet velocity, the interfacial cusp formed between the jet and the liquid pool becomes sharper. At a critical jet velocity, entrainment inception occurs, i.e., the interfacial cusp breaks, the interface ruptures, and air is pulled into the liquid pool. We conduct two-fluid simulations using the Volume-Of-Fluid (VOF) methodology. The large range of length scales in the flow presents a major computational challenge. We postulate an approach based on scaling of the underlying physics and this helps alleviate the constraints that the physics poses on the numerical method. The approach is validated using a simple flow configuration - a cylinder rotating at an interface between two fluids. Our simulations capture the sharpening of the interfacial cusp, and the sudden rupture of the interface. The predicted critical entrainment velocities are within 1% of experimental data, thereby providing confidence in the approach.

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