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A Subgrid Model for Predicting Air Entrainment Rates in Bubbly Flows JINGSEN MA, ASSAD A. OBERAI, DONALD E. DREW, RICHARD T. LAHEY, JR., FRANCISCO J. MORAGA, Center for Multiphase Research, Rensselaer Polytechnic Institute — In this talk we present a fairly simple subgrid air entrainment model that accurately predicts the rate of air entrainment, which is critical in simulating multiphase (air/water) flows. The derivation of this model begins by assuming that a thin sheet of air is carried into the water by the inertia of the liquid at the free surface. A momentum balance on the entrained gas layer results in an expression for the entrained volumetric gas flow rate, in terms of the local liquid velocity, gas viscosity etc., which are readily available from a multiphase RANS-type simulation. This model has been validated against extensive experimental data on both plunging jets and hydraulic jumps over a wide range of liquid velocities. It was implemented in a two-fluid computational fluid dynamics code (CFDShipM) to be used to predict the void fraction distribution underneath a plunging liquid jet at different depths and jet velocities. The results were found to match the experimental observations very well. The application of this model to more challenging problems, including hydraulic jumps and full-scale ship simulations, is currently underway.

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