Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Eulerian Label Advection method for bubble tracking in two-fluid Navier-Stokes simulations[1] DECLAN GAYLO, KELLI HENDRICKSON, DICK YUE, Massachusetts Institute of Technology MIT — The dynamics of bubbles near the air-sea interface have an important impact on many free-surface entrainment driven problems including air-sea gas exchange, waves in the surf-zone, and wake around a vessel. The dynamics are driven by breakup, coalescence, degassing, entrainment, and dissolution, and understanding these processes individually in numerical simulations requires a reliable method to track individual bubbles through time. Tracking methods that solve an inverse problem based Lagrangian properties can be problematic in the presence of multiple processes, which is inherent near the air-sea interface. We present a forward method that uses an Eulerian advection step built upon the conservative Volume of Fluid (cVOF) method to identify the sources of fluid in a grid cell based on labels previously assigned using informed connected-component labeling (ICL). Eulerian Label Advection (ELA) allows us to identify a bubble's history from its air sources, making Lagrangian tracking achievable using a forward Eulerian method. We demonstrate using 3D numerical simulations of two-fluid turbulent flow that ELA is able to track bubbles in the presence of multiple processes, ultimately enabling accurate and independent quantification of the processes involved bubble dynamics.

[1]Office of Naval Research Grant No. N00014-20-1-2059

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Date submitted: 07 Aug 2020 Electronic form version 1.4