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**Multiscale interactions of bubbles with free vortex flows**[1] JUSTIN FINN, EHSAN SHAMS, SOURABH APTE, Oregon State University — We simulate bubble and particle interactions with several types of free vortex flows using both a Discrete Element Model (DEM) and a fully resolved approach. In the DEM approach, DNS is used with Lagrangian particle tracking to compute the motion of a subgrid scale dispersed phase. The *volumetric* displacement of the fluid by the dispersed phase is modeled along with interphase momentum-exchange for more realistic coupling of the dispersed phase to the flow. In the fully resolved approach, a fictitious domain technique is used with refined grids to directly compute the motion of the dispersed phase to obtain high fidelity solutions. First, both approaches are used to simulate bubble entrainment into a stationary Gaussian vortex [Oweis et al. 2005]. Next, bubble entrainment and interaction with a traveling vortex tube [Sridhar & Katz 1999] is simulated using the DEM approach. Finally, a viscous falling 'blob' of particles is simulated [Walther & Koumoutsakos 2001, Mitts 1995], where the dispersed phase generates and interacts with a 3D vortex ring. The results show that the less expensive DEM approach with volumetric coupling is able to capture clustering induced flow distortion, while the fully resolved approach gives insight into dispersed phase scale interactions with the flow.

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