Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Volume Displacement Effects in Bubble-laden Flows ANDREW CIHONSKI, JUSTIN FINN, SOURABH APTE, Oregon State University, School of Mechanical, Industrial and Manufacturing Engineering — When a few bubbles are entrained in a traveling vortex ring, it has been shown that even at extremely low volume loadings, their presence can significantly affect the structure of the vortex core (Sridhar & Katz 1999). A typical Euler-Lagrange point-particle model with two-way coupling for this dilute system, wherein the bubbles are assumed subgrid and momentum point-sources are used to model their effect on the flow, is shown to be unable to accurately capture the experimental trends of bubble settling location and vortex distortion for a range of bubble parameters and vortex strengths. The bubbles experience a significant amount of drag, lift, added mass, pressure, and gravity forces. However, these forces are in balance of each other, as the bubbles reach a mean settling location away from the vortex core. Accounting for fluid volume displacement due to bubble motion, using a model termed as volumetric coupling, experimental trends on vortex distortion and bubble settling location are well captured. The fluid displacement effects are studied by introducing a notion of a volumetric coupling force, the net force on the fluid due to volumetric coupling, which is found to be dominant even at the low volume loadings investigated here.

Andrew Cihonski
Oregon State University, School of Mechanical,
Industrial and Manufacturing Engineering

Date submitted: 30 Jul 2012 Electronic form version 1.4