Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Arbitrary Lagrangian-Eulerian (ALE) formulation for microacoustofluidics[1] NITESH NAMA, TONY JUN HUANG, FRANCESCO COSTANZO, Pennsylvania State University — We present an Arbitrary Lagrangian-Eulerian (ALE) formulation for the analysis of acoustic streaming flows. We employ a multiscale approach to separate the flow variables into first-and second-order components which results in two subproblems: a first-order problem, formulated in terms of the fluid displacement at a fast scale and a second-order problem formulated in terms of the Lagrangian flow velocity at a slow time scale. The Lagrangian velocity based formulation of the second-order problem removes the ambiguity concerning the second-order boundary condition at the oscillating walls and circumvents the need to employ the notion of Stokes drift, thereby allowing a direct comparison with the experiments. Moreover, the ALE formulation offers a natural extension to the more complex fluid-structure interaction problems in microacosutofluidic devices. Lastly, we present numerical test cases where the Eulerian flow velocities exhibit several non-physical features that are not observed in the corresponding Lagrangian flow velocities, indicating that a Lagrangian velocity based formulation is much more favorable and readily interpretable.

[1]This work was supported by the National Science Foundation (CBET-1438126 and IIP-1346440).

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Date submitted: 01 Aug 2016 Electronic form version 1.4