Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

**Numerical Investigation of an Oscillating Flat Plate Airfoil.** FAZLOLAH MOHAGHEGH, MATTHEW JANECHEK, JAMES BUCHHOLZ, HS UDAYKUMAR, University of Iowa — This research investigates the vortex dynamics of a plunging flat plate airfoil by analyzing the vorticity transport in 2D simulations. A horizontal airfoil is subject to a freestream flow at Re=10000. A prescribed vertical sinusoidal motion is applied to the airfoil. Smoothed Profile Method (SPM) models the fluid-structure interaction. SPM as a diffuse interface model considers a thickness for the interface and applies a smooth transition from solid to fluid. As the forces on the airfoil are highly affected by the interaction of the generated vortices from the surface, it is very important to find out whether a diffuse interface solver can model a flow dominated by vorticities. The results show that variation of lift coefficient with time agrees well with the experiment. Study of vortex evolution shows that similar to experiments, when the plate starts moving downward from top, the boundary layer is attached to the surface and the leading-edge vortex (LEV) is very small. By time, LEV grows and rolls up and a secondary vortex emerges. Meanwhile, the boundary layer starts to separate and finally LEV detaches from the surface. In overall, SPM as a diffuse interface model can predict the lift force and vortex pattern accurately.

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Date submitted: 31 Jul 2017 Electronic form version 1.4