Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Development of multiphase Navier-Stokes simulation capability for turbulent gas flow over laminar liquid for Cartesian grids[1] SHA MIAO, KELLI HENDRICKSON, YUMING LIU, Massachusetts Institute of Technology, HARIPRASAD SUBRAMANI, Chevron Energy Technology Company — This work presents a novel and efficient Cartesian-grid based simulation capability for the study of an incompressible, turbulent gas layer over a liquid flow with disparate Reynolds numbers in two phases. This capability couples a turbulent gas-flow solver and a liquid-layer based on a second-order accurate Boundary Data Immersion Method (BDIM) at the deformable interface. The turbulent gas flow solver solves the incompressible Navier-Stokes equations via direct numerical simulation or through turbulence closure (unsteady Reynolds-Averaged Navier-Stokes Models) for Reynolds numbers $O(10^6)$. In this application, a laminar liquid layer solution is obtained from depth-integrated Navier-Stokes equations utilizing shallow water wave assumptions. The immersed boundary method (BDIM) enforces the coupling at the deformable interface, the boundary conditions to turbulence closure equations and defines the domain geometry on the Cartesian grid. Validations are made for the turbulent gas channel flow over high-viscosity liquid. This simulation capability can be applied to problems in the oil and industrial sector such as channel and pipe flows with heavy oils as well as wind wave generation in shallow waters.

[1]Sponsored by the Chevron Energy Technology Company

Kelli Hendrickson
Massachusetts Institute of Technology

Date submitted: 30 Jul 2015 Electronic form version 1.4