A coupled level set–volume of fluid method named as A-CLSVOF is developed and implemented. Four canonical cases have been used to evaluate the method. In the static droplet simulation, A-CLSVOF substantially reduced the spurious currents. The capillary wave relaxation shows that this method delivers results comparable to those of more rigorous methods such as Front Tracking methods for fine grids. In the Rayleigh–Taylor instability simulation, the interface location is qualitatively compared with the results reported by other researchers. In the droplet impact, the demonstrating better agreement, qualitatively and quantitatively, with the experimental result. Next, we implemented interfacial forces by enlisting the finite volume discretization of Ghost Fluid Method. To assess the A-CLSVOF/GFM performance, four cases were studied. In the case of a static droplet in suspension, A-CLSVOF/GFM produces a sharp and accurate pressure jump compared to the traditional CSF implementation. The interaction of viscous and capillary forces is proven to be consistent with theoretical results for the classical capillary wave. For the linear two-layer shear flow, GFM sharp treatment of the viscosity captured the velocity gradient across the interface. For a gaseous bubble rising in a viscous fluid, GFM outperforms CSF with errors of 4.6% and 14.0% respectively. Also, we developed Decoupled Pressure A-CLSVOF/GFM method (DPM) which separates pressure into two pressure components as P1 accounts for interfacial forces such as surface tension and P2 represent the rest of flow pressure. The case of capillary wave is used to evaluate this method. It is proven that the DPM implementation results into more efficiency in PISO loop. Furthermore, we used a two-phase solver to study buoyant oil discharge in quiescent and crossing ambient. We conducted cases with various flow and fluid properties to capture different modes of breakup including dripping, jetting (axisymmetric and asymmetric) and atomization for cross-flow oil jet.

Educational Career:
Bachelor’s of Mechanical engineering, BS, 2009, Qazvin Islamic Azad University
Master’s of Aerospace engineering, MS, 2012, Sharif University of Technology

Committee in Charge:
Ranganathan Kumar, Chair, MAE
Tuhin Das, Department of Mechanical and Aerospace Engineering, University of Central Florida, Orlando, FL
Kareem Ahmed, Department of Mechanical and Aerospace Engineering, University of Central Florida, Orlando, FL
Bhimsen Shivamoggi, Department of Mathematics, University of Central Florida, Orlando, FL

Approved for distribution by Ranganathan Kumar, Committee Chair, on June 11, 2018.

The public is welcome to attend.