Physical Mathematics Seminar

Direct Numerical Simulation of Multi-Component Flows

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Abstract

We report the development of a sharp interface/level set method for the Direct Numerical Simulation (DNS) of multi-component flows. Special care has been taken to treat problems involving high-density ratios and large surface tension forces in an accurate and computationally efficient manner. Calculations are presented for 2D waves falling down a vertical wall, wherein good agreement is found with the experiments of Nosoko et al. (1996). Also, we develop a semi-analytical calculational methodology for interfacial mass transfer at high Schmidt numbers, and compare the results with the experiments of Emmert and Pigford (1954) with which good agreement was found. In addition, fully 3D turbulent calculations are performed for a liquid film falling along an inclined plane. Our turbulence calculation is validated against DNS in the literature where no interfacial deformations are allowed. Also, vortical structure/interface interactions are investigated for the case where the interface is allowed to deform. Finally, as the method developed is general in nature, current and future applications to non-Newtonian fluids, systems with irregular geometries and homogenization are discussed.

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