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The Numerical Simulation of Gas-Liquid Two-Phase Flow in a Horizontal Rectangular Channel

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Results shall be reported for the 2D numerical simulation of air-water two-phase flow in a rectangular channel. By varying the different material properties and boundary conditions for the two-phase pipe flow, plug, slug, and bubble pipe flows are numerically reproduced. The effect of varying the liquid viscosity leads to interesting terminal two-phase pipe flow scenarios. The Navier-Stokes equations for two-phase flow are numerically solved. The deforming gas-liquid boundary is numerically represented by the Volume-of-Fluid (VOF) method and the Efficient Least Squares Volume-of-fluid Interface Reconstruction Algorithm (ELVIRA) is used to determine the slope of the piecewise linear reconstructed interface. A multiphase projection algorithm, as described in the paper by Jemison et al (Journal of Scientific Computing, 2013), was implemented in order to integrate the momentum equations in time. It shall be demonstrated that the "hybrid multiphase projection+ELVIRA" algorithm is robust and enables one to reproduce complicated two-phase pipe flows with severe flow conditions to include very fast superficial gas and/or liquid velocity.

Keywords: Gas-liquid pipe flow, Two-phase flow, Numerical analysis, VOF Method