Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

CFD-informed unified closure relation for the rise velocity of Taylor bubbles in pipes ENRIQUE LIZARRAGA-GARCIA, Department of Mechanical Engineering, Massachusetts Inst of Tech-MIT, JACOPO BUONGIORNO, Department of Nuclear Science and Engineering, Massachusetts Inst of Tech-MIT, EISSA AL-SAFRAN, Petroleum Engineering, Kuwait University, DJAMEL LAKEHAL, ASCOMPT — Two-phase slug flow commonly occurs in gas and oil systems. Current predictive methods are based on the mechanistic models, which require the use of closure relations to complement the conservation equations to predict integral flow parameters such as liquid holdup (or void fraction) and pressure gradient. Taylor bubble velocity in slug flow is one of these closure relations which has been determined to significantly affect the calculation of these parameters. In this work, Computational Fluid Dynamics (CFD) with Level-Set as the Interface Tracking Method (ITM) are employed to simulate the motion of Taylor bubbles in slug flow, for which the commercial code TransAT is used. A large numerical database with stagnant and flowing liquid for various Reynolds numbers is being generated from which a unified Taylor bubble velocity correlation in stagnant liquids for an ample range of fluid properties and pipe geometries is proposed ($Mo \in [1 \cdot 10^{-6}, 5 \cdot 10^{3}], Eo \in [10, 700]$). Furthermore, it is found that the velocity of Taylor bubbles in inclined pipes is greatly affected by the presence of a lubricating thin film between the bubble and the pipe wall. An analytical and experimentally validated criterion, which predicts the film existence, draiage and breakup, is presented.

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Date submitted: 29 Jul 2015 Electronic form version 1.4