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Smart Tomographic Sensors for Advanced Industrial Process Control

An hybrid Lagrangian-IBM method for the CFD of inline bubbly flow separation

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Abstract

Inline fluid separation using a swirl element is a recent technology for oil/gas processing. Centrifugal forces up to 100 times the gravitational acceleration separate the phases, leaving the heavy phase next to the wall and the light one in the center. The current study is part of a Europeen project TOMOCON aiming at developing CFD methods in the in-house code JADIM to simulate the two phase flow separation. Ta handle the scale range from some meters for the length of the device (pipe, swirl element) to 10^{-6} m, the size of the smallest bubbles and drops, the numerical strategy combines Eulerian and Lagrangian approaches. First, Immersed Boundary Method [1] is used to simulate both the pipe and the complex geometry of the swirl element on a simple regular mesh. The characteristic of the swirling flow and in particular the decay of the swirl downstream are analyzed for different pipe Reynolds numbers. Then Lagrangian tracking [2] of bubble is conducted to study bubbles separation. We show that the bubble capture depends on the relative contribution of the inertial centripetal acceleration and the lift force that pushes the bubble to the wall. Numerical simulations of this industrial process will help fixing the physical parameters which influence the separation and control the efficiency and the numerical results and will be validated with experimental data from TU Delft, TUL and HZDR.

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