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DNS of two-phase flow in an inclined pipe FANGFANG XIE, Zhejiang University, XIAONING ZHENG, Brown university, MICHAEL TRIANTAFYLLOU, Massachusetts Institute Technology, YIANNIS CONSTANTINIDES, Chevron Energy Technology Company, GEORGE KARNIADAKIS, Brown university — We study the de-stabilization mechanisms of two-phase flow in an inclined pipe subject to gravity with a phase-field approach. At the inlet, a stratified flow is imposed with a parabolic velocity profile. We found that due to gravity, the stratified flow will become unstable, causing a complex transitional flow inside the pipe. Firstly, a 2D channel geometry is considered. When the heavy fluid is injected in the top layer, inverted vortex shedding emerges, interacting periodically with the bottom wall as it develops further downstream. The accumulation of heavy fluid in the bottom wall causes a backflow, which interacts with the previous jet. On the other hand, when the heavy fluid is placed in the bottom layer, a big slug is formed and subsequently breaks into small pieces, some of which will be shed along the pipe. To describe the generation of vorticity from the two-phase interface and pipe walls, we analyze the circulation dynamics and connect it to the two-phase flow pattern. Moreover, we analyze the two-phase flow induced forces along the pipe, which is capable of producing unwanted and destructive vibrations. Finally, we conduct 3D simulations in the circular pipe and compared the differences of flow dynamics against the 2D simulation results.

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