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A front tracking technique for direct numerical simulations of multiphase flows in complex geometries[1] KOHKI ISHII, ASGHAR ESMAEELI, Southern Illinois University at Carbondale — Experimental studies have been the main thrust of microfluidic research so far; however, numerical simulations are gradually gaining acceptance as their importance is being more and more recognized by researchers in the field. Accurately capturing the liquid/liquid or liquid/gas interface is only part of the challenge in simulating fluid flow in lab-on-a-chip; the complex solid boundaries must also be accurately represented. Handling complex boundaries has been one of the challenges of CFD from the very beginning and one can identify roughly three stages. Crude representation of curved boundaries on a fixed grid by stair-stepping, body-fitted structured grids, and body-fitted unstructured grids. Current commercial codes almost exclusively use some variants of the last approach. However, while very common, unstructured grids generally lead to inefficient and inaccurate codes. Here, we present a front tracking technique to simulate the motion of drops and bubbles through complex geometries using regular structured meshes, where solid boundaries are represented as immersed boundaries and fluid boundaries are explicitly tracked. The methodology is validated and the code is used to study the dynamics of pressure-driven bubbles in a complex network of channels.

[1]ORDA-SIUC

Asghar Esmaeeli
Southern Illinois University at Carbondale

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