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Generalized Navier Boundary Conditions for ALE two-fluid simulations

We are interested in the numerical simulation of two incompressible viscous fluids separated by a free interface. We use an Arbitrary Lagrange Euler (ALE) formulation of the problem. The purpose of the talk is to address various numerical issues, in particular some stability and conservation properties. The role of the Geometric Conservation Law (GCL) will be discussed. We will introduce a notion of "Surface Conservation Law" which may be helpful to analyse the numerical scheme when the surface tension is taken into account. A difficult problem in the modelling of two-fluid flows in a bounded domain concerns the displacement of the contact line, namely the points which are at the intersection of the boundary of the domain and the interface separating the two fluids. We will show that variational formulations are well-suited to the "Generalized Navier Boundary Conditions" introduced by Qian, Wang and Sheng. Owing to these boundary conditions, it is possible to circumvent the incompatibility between the classical no-slip boundary condition and the fact that the contact line of the interface on the wall is actually moving. We will present numerical experiments on two-fluid flows in narrow channels and we will compare these results with molecular dynamics simulations from the literature.

This is a joint work with T. Lelièvre.