A new approach for the simulation of two-phase flow with sharp interface

Antoine Quiriny[1], Jonathan Lambrechts[1], Nicolas Moës[2], Jean-François Remacle[1]

[1]) Institute of Mechanics, Materials and Civil Engineering (iMMC), Avenue Georges Lemaître 4, 1348 Louvain-la-Neuve, Belgium
{antoine.quiriny, jonathan.lambrechts, jean-francois}@uclouvain.be
[2]) Nantes Université, École Centrale de Nantes, Rue de la Noë, 44321 Nantes, France
Institut Universitaire de France (IUF)
nicolas.moes@ec-nantes.fr

Accurate modeling of moving boundaries and interfaces is a difficulty present in many situations of computational mechanics. When a physical model involves discontinuous material properties, interfaces can develop/nucleate, grow, change topology or disappear. These interfaces can be material or immaterial, depending on whether the material particles move with the interface or not. The position and speed of these interfaces is not known in advance and is part of the computation. In this presentation, we will consider the case of material interfaces and in particular those between two immiscible fluids which material properties such as viscosity or density are discontinuous. The existence of surface tension adds for the possibility of a pressure jump at the interface between the two fluids.

We use a new approach, X-Mesh, to simulate with the finite element method the interaction between two immiscible flows while keeping an accurate and sharp description of the interface without remeshing. The surface tension between the two fluids is added thanks to the ghost fluid method which when coupled with X-Mesh allows us to be exactly sharp in the pressure jump. This reduces the parasitic currents due to the surface tension down to the numerical precision.