Postdoctoral research training

Numerical simulation of two-phase flow by a level-set method applied to the coalescence between two bubbles

Laboratories:

Laboratoire Jean Kuntzmann (UMR 5224), 51 rue des Mathématiques, Campus de Saint Martin d'Hères - BP 53, 38041 Grenoble cedex 09

Surface du Verre et Interfaces (UMR 125 CNRS/Saint-Gobain), 39 quai Lucien Lefranc, 93303 Aubervilliers cedex

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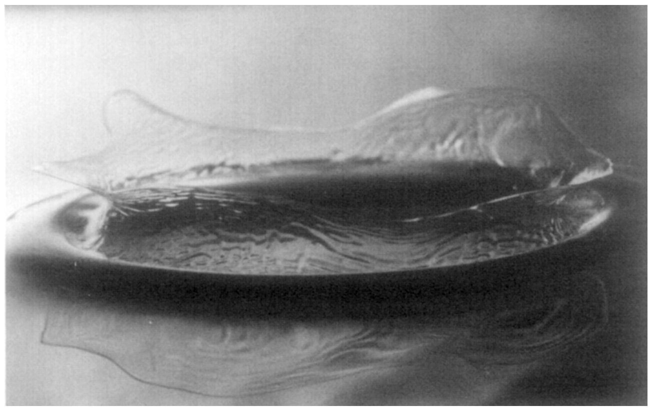

Figure 1: Rupture of a bubble at a free surface of a liquid according to Hermann et Mesler (1987).

Problem statement

Many industrial processes involve two-phase flows for which the dynamics is very important for the design of industrial plants. It is particularly true for the glass melting process for which a huge amount of bubbles is produced by chemical reactions or by pneumatic devises. Due to the large value of dynamic viscosity, the bubble removal achieved by gravity takes a long time. Consequently, it is crucial to avoid the creation of tiny bubbles.

The creation of small bubbles has been also observed when a bubble breaks at a free surface of a liquid (see Figure 1). The occurence of these tiny bubbles should be due to the film instability during the film retraction leading to a crown of gas which destabilizes further in bubbles. It has been observed that the pneumatic devices lead to a creation of "micro-bubbles" occuring when two larger bubbles coalesce in the bulk. The tiny bubbles are carried by the continuous phase and can not be removed by gravity due to their too small size. So, it becomes crucial to understand how these "micro-bubbles" appear to prevent their formation.

The aim of this postdoctoral work is to investigate the coalescence of two bubbles and track accurately the film created between the two bubbles before and after its rupture. The main issues addressed here is to find the physical mechanisms leading to the "micro-bubbles" creation. In order to study this phenomena, a numerical method will be developed based on the resolution of Navier-Stokes equations coupled with an implicit tracking of interfaces between the two phases (level-set method) very well adapted to study the topological changes. The discretization will be achieved with a finite-element method using the C++ library rheolef. In parallel of this numerical investigation, an experimental work is scheduled at Saint-Gobain Recherche in order to compare with the numerical simulations.

Postdoctoral schedule and support

This postdoctoral position will be mainly held in the laboratory Jean Kuntzmann localized at the university Joseph Fourier at Grenoble (France) with short stays at Saint-Gobain Recherche localized at Aubervilliers close to Paris (France). It is supported by the Agence pour les Mathématiques en Interaction avec l'Industrie et la Société and is scheduled for 18 months.

Required profile

We are looking for a young scientist with a strong background in Fluid Mechanics who has done a Ph. D. thesis in numerical analysis applied on the resolution of non-linear partial differential equations like Navier-Stokes equations.