A local mass conservation Method for the Level Set Method applied to two-phase incompressible flow subjected to break-up

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ABSTRACT

Interface motion in the case of two-phase incompressible flow simulation is of important interest for applied research. This subject sets a difficult approximation problem: **Lagrangian Methods** present difficulties to simulate break-up events,**Eulerian Methods** present difficulties to advect the interface with a good accuracy. In the set of **Eulerian Methods**, the Level Set one developped in the early $80^{\prime s}$ by Osher and Setian ([1],[2]) using the zero level contour of a smooth function to locate the interface opens the possibility to get high accuracy. In case of break-up or coalescence events, the level set method allows reconnection and deconnection of the interface in a natural way thanks to the zero level set contours.

Nevertheless for two-phase incompressible flow, the level set method does not ensure naturally mass conservation and it has to be enforced. A global mass conservation algorithm is satisfying in case of flows not subjected to break-up events ([3]). However in the contrary cases for example the break-up occuring due to capillary effects, a local mass conservation algorithm is necessary. First the mass loss is much more important in the break-up occuring area because the accuracy is lower due to discontinuities in the velocity field. Secondly each disconnected mass has to be enforced alone. In this paper, we shall present a local mass conservation enforcement method.

Our method is aplied to three-dimensionnal axisymmetric break-up test case: the capillary instability of a water column and the pendant drop formation process under gravity. We compare our results with experimental data ([4],[5]). We study the accuracy behaviour before, during and after break-up events. We evaluate the improvement on accuracy and mass conservation due to our local mass conservation method.

Keywords : incompressible two-phase flow, surface tension, break-up, mass conservation

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