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Research article

Application of level set method for modeling of immiscible liquids with large surface tension

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One of the most important advantages of the level set method is its ability to automatically handle topological changes. Instead of explicitly tracking the interface between the media, the level set method describes them as a zero isosurface of the level set function. This allows numerical modeling of the dynamics of a multiphase fluid as a single medium with varying parameters. It is known that a disadvantage of this approach is the possibility of non-physical oscillations of the velocity field near the interface, which occur at high surface forces due to the error in calculating the curvature of the interface and high gradients of other functions in the transition layer. Another disadvantage of the method is the problem of preserving the masses of liquids during the simulation. In this paper, several modifications of the level set method are described that allow reducing the mass loss of liquids, improving the convergence in the implicit solution of the transport equation, and reducing velocity oscillations near the interface in the case of high values of the surface tension coefficient. The proposed approaches were tested on a standard test problem of the dynamics of two immiscible liquids.

Keywords: level set method, immiscible liquids, numerical modeling, surface tension, finite volume method

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