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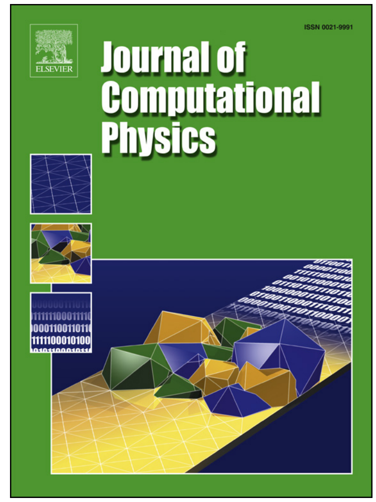

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An immersed boundary method for the simulation of bubbles with varying shape

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Abstract

The paper presents a numerical method for the simulation of bubbles with variable shape in the framework of an immersed boundary method. The liquid-gas interface is described analytically by a series expansion in spherical harmonics. Such a representation of the interface is very accurate and robust and the error of the computed surface curvature is substantially smaller compared to a discrete representation of the surface by grid points. The shape of the bubble is computed by minimizing the local displacement energy of pressure and surface tension forces and is coupled to the continuous phase by adapting the Lagrangian surface mesh in each time step. This is done with the constraint of constant bubble volume exactly implemented. As a first step the bubbles are restricted to axisymmetric shapes. The resulting algorithm is thoroughly validated by several numerical tests and finally applied to freely rising bubbles with stationary and oscillatory shape as well. The computed bubble shapes are in very good agreement with experimental and numerical reference data.

Keywords:
immersed boundary method, multiphase flow, bubble, variable shape, fluid-structure interaction

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