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TRANSPORT PHENOMENA & FLUID MECHANICS

权重积分方法计算界面张力消除表面“寄生”流

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摘要 Parasitic flows may occur in the numerical simulation of incompressible multiphase flow due to errors in the calculation of surface tension terms, specifically for the curvature and unit normal vector. An improved method for calculating the surface tension based on the level set approach is proposed, in which the contribution of not only the center node but also the rest area of a control volume to the calculation of surface tension is considered in a balanced manner. The weighted integration method (WIM) is more consistent with the concept of a banded interface in the level set method. It is applied to the temporal evolution of a two-dimensional neutrally buoyant liquid drop and a buoyancy driven deformable bubble in an immiscible fluid for the validation of WIM. The results show that the parasitic flows are evidently suppressed by the weighted integration method. The weight factors for WIM in 2-D cases are also suggested.

关键词 parasitic flow; weighted integration method; surface tension; level set approach; numerical simulation;
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A simple weighted integration method for calculating surface tension force to suppress parasitic flow in the level set approach

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Abstract Parasitic flows may occur in the numerical simulation of incompressible multiphase flow due to errors in the calculation of surface tension terms, specifically for the curvature and unit normal vector. An improved method for calculating the surface tension based on the level set approach is proposed, in which the contribution of not only the center node but also the rest area of a control volume to the calculation of surface tension is considered in a balanced manner. The weighted integration method (WIM) is more consistent with the concept of a banded interface in the level set method. It is applied to the temporal evolution of a two-dimensional neutrally buoyant liquid drop and a buoyancy driven deformable bubble in an immiscible fluid for the validation of WIM. The results show that the parasitic flows are evidently suppressed by the weighted integration method. The weight factors for WIM in 3-D cases are also suggested.

Key words parasitic flow; weighted integration method; surface tension; level set approach; numerical simulation;

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