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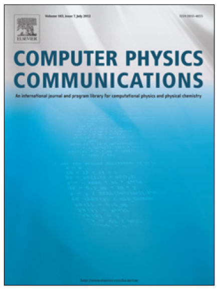

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Accuracy and stability enhancements in the incompressible finite-volume-particle method for multiphase flow simulations

Xiaoxing Liu[1], Ryusei Ogawa[1], Masatsugu Kato[1], Koji Morita[1] and Shuai Zhang[2]

[1]*Department of Applied Quantum Physics & Nuclear Engineering, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan*

[2]*School of Aeronautics and Astronautics, Zhejiang University, 38 Zheda Road, Hangzhou, Zhejiang 310027, China*

ABSTRACT

For the simulation of multiphase flows, an incompressible finite volume particle (IFVP) method is proposed that offers enhanced accuracy and stability. A high-order multiphase Laplacian operator is derived by combining the gradient model and divergence model. To produce enhanced accuracy, neighboring dummy particle are introduced in each dimension of the calculation and used for the discretization of the gradient model. The error-compensating terms produced by introducing these dummy particles assist in the higher-order calculations of the gradient operator. Consequently, Accuracy of the Laplacian operator is enhanced consistently by these error-compensating terms. Compared to the single dummy particle introduced for two-dimensional calculations in our previous work [16], the proposed high-order scheme is more generalized and can be applied in the calculation of arbitrary dimensions. This enhanced multiphase scheme provides accurate and stable calculations of multiphase flows characterized by high density ratios. An advantage of this scheme is that the separation of two liquids of similar density is easily handled as well. Results of several numerical simulations are given to demonstrate its validity and enhanced performance.

Keywords:

Multiphase flow; Particle method; Accuracy; Stability; FVP method

1. Introduction

Particle methods have proven useful in the simulation of multiphase flows. The shape of the interface is directly obtained from the set of computational particles. As a