

A pressure-based method for low Mach number two-phase flows with mass transfer

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We present a pressure-based method for the numerical solution of a four-equation two-phase compressible flow model with mass transfer [1]. The proposed methodology has the capability to simulate low Mach number multiphase flows with phase change such as boiling flows. The considered model assumes kinetic, mechanical and thermal equilibrium between the two phases, and in its primitive variable formulation it is composed of the equations for the volume fraction, the temperature, the velocity and the pressure. The model includes the effects of viscosity, surface tension, thermal conductivity and gravity. Mass transfer is modeled through a Gibbs free energy relaxation term. We employ an operator splitting algorithm where we first solve the model equations with no mass transfer terms via a pressure-based method on a staggered Cartesian grid, and then we apply a relaxation procedure to integrate these transfer terms accounting for phase transition [2]. A key feature of the proposed pressure-based methodology is the use of high performance and scalable solvers for the solution of the Helmholtz equation for the pressure, which drastically reduces the computational cost. Several numerical tests are presented to demonstrate the effectiveness of the proposed method, including tests involving flows with large density ratios, flows at low Mach number, and a challenging three-dimensional nucleate boiling simulation.

REFERENCES

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