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Decoupled, energy stable scheme for Cahn-Hilliard phase field model of two-phase incompressible flows

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In this paper, an efficient, totally decoupled and energy stable scheme is presented for the Cahn-Hilliard phase field model of two-phase incompressible flows. The rigorous proof of unconditional energy stability for the semi-implicit scheme and the fully discrete scheme are provided. The scalar auxiliary variable (SAV) approach is implemented to solve the Cahn-Hilliard equation while a splitting method based on the pressure stabilization is used to solve the Navier-Stokes equation. At each step, the scheme involves solving only a sequence of linear elliptic equations, including a pressure Poisson equation. An efficient finite difference spatial discretization on the staggered grids is applied to verify the accuracy and efficiency of the proposed schemes. Numerical results in both 2D and 3D demonstrate that the proposed schemes is very efficient, accurate and energy stable.

References

Shen, Jie, Jie Xu, and Jiang Yang. "The scalar auxiliary variable (SAV) approach for gradient flows." Journal of Computational Physics 353 (2018): 407-416.

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