Fully implicit and accurate treatment of jump conditions for two-phase incompressible Navier–Stokes equation

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ABSTRACT

We present a numerical method for two-phase incompressible Navier–Stokes equation with jump discontinuity in the normal component of the stress tensor and in the material properties. Although the proposed method is only first-order accurate, it does capture discontinuity sharply, not neglecting nor omitting any component of the jump condition. Discontinuities in velocity gradient and pressure are expressed using a linear combination of singular force and tangential derivatives of velocities to handle jump conditions in a fully implicit manner. The linear system for the divergence of the stress tensor is constructed in the framework of the ghost fluid method, and the resulting saddle-point system is solved via an iterative procedure using recently introduced techniques by Egan and Gibou [2]. Numerical results support the inference that the proposed method converges in L^∞ norms even when velocities are not smooth across the interface and can handle a large density ratio that is likely to appear in a real-world simulation.

REFERENCES

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