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Solving compressible, multiphase flows with pressure projection and relaxation MICHAEL KUHN, OLIVIER DESJARDINS, Cornell University — Simulating compressible, multiphase flows presents unique challenges in terms of stability, with a wide range of scales and discontinuities from shocks and material interfaces. A well-rounded solver must address how to represent interfaces, transport discontinuous variables, and limit numerical dissipation. Also, since the sound speed and Mach number can vary significantly, pressure projection schemes are useful in providing stability and computational efficiency by removing the acoustic limit on the time step. However, the application of projection methods to these flows is limited in the literature, leaving open questions as to how the pressure in each phase should contribute to the pressure projection equation. Pressure relaxation frameworks described by Saurel et al. (JCP 2009) and Pelanti and Shyue (JCP 2014) provide a straightforward approach to reconciling the pressures in each phase, but these have been exclusively applied in Riemann-based solvers. In this work, we integrate pressure projection and pressure relaxation in the same framework, enabling improvements in stability via consistency. We demonstrate the capabilities of our scheme by simulating several test cases, including underwater bubble-wave interactions and a liquid jet in supersonic crossflow.

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