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Application of a Piecewise Barotropic Equation of State in a Homogeneous Equilibrium Mixture (HEM) Cavitation Model JOSHUA BRINKERHOFF, SAEED RAHBARIMANESH, University of British Columbia, IOANNIS KARATHANASSIS, MANOLIS GAVAISES, City, University of London — The commonly-used homogeneous equilibrium mixture (HEM) cavitation models lack accurate treatment of two phase flow properties at mixture saturation states, which leads to miscalculation of pressure and density in computational fluid dynamics (CFD) simulations. This issue can be addressed by employing a reliable barotropic equation of state (EOS) in the cavitation model. The current study presents a piecewise EOS that can accurately capture flow properties at liquid, vapor, and transition states. Implementing the proposed EOS in a HEM solver to simulate the cavitating flow of diesel in a throttle shows a better match against mass flow rates measured in experiments than a single-step EOS approach. The improvement is due to the enhanced functionality of the solver in relaxing sharp pressure and density gradients during condensation and vaporization processes. The lack of such capability in the single-step model seems to cause additional numerical diffusion in shear layers and interface regions, particularly in areas with stronger condensation, resulting in poorly predicted cavitation. The work is a step towards the main objective of improving HEM cavitation modeling in CFD of cryogenic fluids.

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