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Relative energy approach to a diffuse interface model of a compressible two-phase flow

Abstract

We propose a simple model for a two-phase flow with a diffuse interface. The model couples the compressible Navier-Stokes system governing the evolution of the fluid density and the velocity field with the Allen-Cahn equation for the order parameter. We show that the model is thermodynamically consistent, in particular, a variant of the relative energy inequality holds. As a consequence, we show the weak-strong uniqueness principle, meaning any weak solution coincides with the strong solution emanating from the same initial data on the life span of the latter. Such a result plays a crucial role in the analysis of the associated numerical schemes. The weak-strong uniqueness principle allows us also to perform the low Mach number limit obtaining the standard incompressible model.