Closure conditions for a non-equilibrium multi-component model with miscible constraints

Jean BUSSAC, Laboratoire de Mathématiques Jean Leray - Nantes Université

Multiphase flow studies have a wide range of applications, especially in the nuclear framework. It is crucial to propose models accounting for the dynamical and the thermodynamical disequilibrium. The multi-component models have been mainly studied in the two-fluid case, with recent extensions in the three and four-fluid situation, see [2] and [1].

Here we propose a generalization of [3]. We investigate a non-equilibrium model for compressible multi-component mixture of N immiscible phases. The present work considers a miscibility hypothesis on the phases.

It consists in considering that one of the N immiscible phases can contain $K \geq 1$ miscible components, thus the fluid is composed of $M = N + K - 1$ components. The case $M = 3$ and $N = 2$ corresponds to [2], and the case $M = 4$ with $N = 3$ to [1].

The fluid is supposed to be out of equilibrium, and each component is described by an Euler type system of equations, with its own velocity. This model is subject to the choice of interfacial terms as well as relaxation terms, that must comply with the second law of thermodynamics.

We investigate the analysis of the model (hyperbolicity, symmetrization) and give a sufficient condition on the interfacial velocity in order to have uniquely defined interfacial pressure terms.

[1] J.-M. Hérard, O. Hurisse, L. Quibel. *A four-field three-phase flow model with both miscible and immiscible components.* ESAIM : Mathematical Modelling and Numerical Analysis, **55**, S251–S278, 2021.

[2] J.-M. Hérard, H. Mathis. *A three-phase flow model with two miscible phases.* ESAIM : Mathematical Modelling and Numerical Analysis, **53(4)**, 1373–1389, 2019.

[3] S. Müller, M. Hantke, P. Richter. *Closure conditions for non-equilibrium multi-component models.* Continuum Mechanics and Thermodynamics, **28(4)**, 1157–1189, 2016.

Contact : jean.bussac@univ-nantes.fr