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A multiscale numerical scheme for the simulation of dispersed multiphase flows

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ABSTRACT

The aim of this talk is to derive both a model and a numerical scheme for the approximation of multiphase models of Baer & Nunziato types [2, 7].

Such models are *averaged* models, able to both model interface flows and well mixed flows. They can be obtained by averaging Euler models following ideas developed in [3]. A new averaging method was developed in [5], based on an explicit stochastic model. We will show that the multiscale model obtained contains several known models in some limits (e.g. nonconservative and relaxation terms of [7, 5]), and also that it ensures in general all phasic entropy inequalities.

Then, we will also show that the same method can be applied at the discrete level for deriving a numerical scheme, based on the ideas of [1, 4]. This numerical scheme will be proven to ensure also positivity and all the entropy inequalities under CFL conditions that can be explicitly derived. As the model, the numerical scheme is multiscale in the sense that it depends on a parameter modeling the local topology of the flow.

Last, a simple model for the topological parameter will be discretized, and numerical results with this micro-macro model will be presented.

References

- [1] R. Abgrall and R. Saurel. Discrete equations for physical and numerical compressible multiphase mixtures. *J. Comput. Phys.* (2003).
- [2] M. R. Baer and J. W. Nunziato. A two-phase mixture theory for the deflagration-to-detonation transition (DDT) in reactive granular materials, *International Journal of Multiphase Flow* (1986).
- [3] D. A. Drew and S. L. Passman. *Theory of multicomponent fluids*, volume 135 of *Applied Mathematical Sciences*. Springer-Verlag (1999).
- [4] E. Franquet and V. Perrier. Runge-Kutta discontinuous Galerkin method for the approximation of Baer and Nunziato type multiphase models. *J. Comput. Phys.*, 231(11):4096–4141, 2012.
- [5] V. Perrier and E. Gutiérrez. Derivation and Closure of Baer and Nunziato Type Multiphase Models by Averaging a Simple Stochastic Model, *Multiscale Modeling & Simulation* (2021).
- [6] V. Perrier and E. Franquet. Runge–Kutta discontinuous Galerkin method for the approximation of Baer-and-Nunziato type multiphase models, *J. Comput. Phys.* (2012).
- [7] R. Saurel and R. Abgrall. A multiphase Godunov method for compressible multifluid and multiphase flows, *J. Comput. Phys.* (1999).