Modeling and simulation of compressible two-phase flows

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Two-phase flows are very present in industry and nature. Typical examples go from pressurized water reactors [3] to the wave breaking [1] and powder-snow avalanches [2]. However, the mathematical modeling of two-phase flows is challenging and still represents several substantial difficulties. We can also mention that currently there is no consensus on these questions among specialists in this field.

We begin our exposition by presenting the six-equations model [3] (a compressible two-phase model with two velocities and two energies, one for each phase). However, this model is quite complex and its advection operator may become non-hyperbolic. Through the velocity relaxation procedure and the Chapman-Enskog expansion [4], we derive a compressible single velocity single energy model [1] (the so-called four-equations model). This formulation is more accessible for efficient numerical simulations. Nevertheless, if one wants to simplify further this model, we can perform the low Mach number asymptotic expansion to filter out acoustic effects [4].

Finally, we will discuss the discretization of the four-equations model in the framework of finite volumes method. We will also present a few numerical applications concerning the wave impact problem and powder-snow avalanches flows.

References

[1] DIAS, F., DUTYKH, D. & GHIDAGLIA, J.-M. 2010. A two-fluid model for violent aerated flows. *Comput. & Fluids.* **39(2)**, 283–293.

[2] DUTYKH, D., ACARY-ROBERT, C. & BRESCH, D. 2010. Numerical simulation of powder-snow avalanche interaction with an obstacle. *Submitted.*

[3] ISHII, M. & HIBIKI, T., 2006. Thermo-fluid dynamics of two-phase flow. *Birkhäuser*

[4] MEYAPIN, Y., DUTYKH, D. & GISCLON, M., 2010. Velocity and energy relaxation in two-phase flows. *Stud. Appl. Maths.* Accepted.