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NUMERICAL METHODS FOR DIFFUSE INTERFACE MULTIFLUID MODELS

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Multiphase flows are involved in numerous engineering applications and a large variety of domains. For example, such flows are encountered in the aerospace industry within all kinds of reaction engines involving liquid reactants injected in the combustion chamber. In this context, the use of numerical simulations for the design and optimisation of industrial devices is increasingly developing, and it is therefore crucial to develop more and more reliable and efficient numerical platforms. Due to the complexity of such multiphase flows in realistic industrial applications, diffuse interface multifluid models seem the best suited for this task. From the most general 7-equation model allowing the fluids to be locally in full desequilibrium [1, 2], it is possible to derive a hierarchy of models by successive relaxations considering infinitely small relaxation times. This gives rise to some well-known models such as the 4-equation model [3, 4], the 5-equation model [5, 6], or the 6-equation model with immediate pressure relaxation which has gained much attention in the past decade [7–10]. For all these models to be applicable to realistic engineering applications, it is essential to build numerical methods that are both robust and accurate, while being time-affordable and compatible with complex geometries and general unstructured meshes.

In this talk, we describe some numerical methods developed in the simulation platform Cedre to solve multifluid models with a view to realistic industrial applications. A compressive technique to reduce the numerical diffusion of the interface is implemented in the framework of multislope MUSCL reconstructions. In order to deal with configurations possibly exhibiting the whole range of Mach numbers, low-Mach corrections are also implemented in the HLLC Riemann solver. We then illustrate and validate these numerical techniques on challenging test-cases, such as a shock-droplet interaction case.

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