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Simulations of non homogeneous viscous flows with incompressibility constraints

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Abstract. *This presentation is an overview on the development, in a series of works with C. Calgaro, E. Creusé and S. Krell, of numerical methods for the simulation of systems of PDEs describing certain mixture flows. These models couple mass conservation and momentum balance equations, together with a constraint which involves the velocity field and the gradient of the density. We will give some hints on the derivation of such models, interpreting the constraint as a condition on the mean volume velocity of the mixture. For the numerical simulation the difficulty consists in handling equations of different types, roughly speaking transport and diffusion equations. We will present two strategies. The former is based on a hybrid approach, coupling Finite Volume and Finite Elements methods. The latter extends Discrete Duality Finite Volume schemes for such non homogeneous flows. The methods are validated on standard test cases for incompressible flows (Rayleigh–Taylor instability, falling droplet). We will also present application to powder–snow avalanches, based on the so–called Kazhikov–Smagulov system.*