Simulation of multi-material flows with coupled smoothed particle and finite volume methods

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The solution of basic and applied research problems is accompanied by high-performance computing of complex physical phenomena. The mathematical predictions in engineering are usually based on the continuum mechanics of a multi-material medium. By now a great number of numerical schemes for discretization and integration of continuum mechanics equations have been developed, of which three main classes can be distinguished: finite volume methods (FVM), finite element methods (FEM) and smoothed particle hydrodynamics (SPH). Each of these has an established area of applications, so the range of problems to be solved may be broadened by introducing coupling algorithms for these methods. Since FVM and FEM coupling has been developed for various problems, their coupling to SPH method is a challenging task [1].
In this study the coupling algorithm for SPH and FVM is developed to model multi-material flows using both approaches simultaneously. It requries special interfaces between SPH and FV domains [2] where the conservative re-interpolation is applied at each simulation step. The particles flow into a mesh region is accompanied by the deletion of particles, while the outflow from the FV/SPH interface should lead to the particles creation. The application of the algorithm to applied problems is demonstrated.

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[2] Chiron L, Marrone S, Di Mascio A and Le Touzé D 2018 *Journal of Computational Physics* **364** 111–136