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Two-phase flow simulations through a contraction

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ABSTRACT

To simulate fluid-solid two-phase flows at a macroscopic level, two choices can be made: if the flow is dilute enough, a discrete particle model may be used in which the trajectory of each particle is calculated within the continuous fluid, however, if the flow becomes dense the two-fluid model [3] is the most practical. In the latter, a continuum description is employed for both the fluid phase and the particle phase. We are interested in simulating dense liquid-solid flows and therefore choose the two-fluid model.

A number of interesting mathematical problems are present in the two-fluid model, such as the hyperbolic-elliptic splitting of the model, the choice of a suitable set of boundary conditions and the presence of nonconservative products in the hyperbolic part (see [1] for details on coping with nonconservative products within the discontinuous Galerkin finite element method (DGFEM)). Furthermore, source terms modeling the interaction between the liquid phase and the solids phase are the cause of a very stiff system. We present a numerical scheme to overcome these problems and show 2D simulations of fluid-solid flows through a contraction.

The goal of our research is to simulate 3D fluid-solid flows through a contraction, including free-surface boundaries for which moving and deforming grids may be required. The space-time DGFEM is well capable of dealing with these requirements [3], motivating our choice to use the space-time DGFEM. Currently, laboratory experiments are being performed to which we eventually want to compare our numerical data.

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