ON SOLID-FLUID MIXTURE MODELS FOR HIGH PARTICULATE VOLUME FRACTIONS

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This work presents a computational model for the particle transport in fluids for applications such as sanding or drilling. A CFD-DEM model is selected to represent the physics of each particle, combined with a continuum approach for the background fluid. Due to this combination, its computational effort is still realistic among the approaches relying on the physics of individual particles. The high particle load in combination with particle deposition and particle interaction renders this model more suitable than approaches relying on global assumptions on the solid phase. The CFD model relies on the incompressible Navier-Stokes equations and is extended in order to take into account the particle interaction. For discretization, a high-order discontinuous Galerkin (DG) approach is chosen [1], which is robust for high Reynolds numbers. Its high computational efficiency allows us to approach large problems with high turnaround times. In each time step, the particle ensemble exerts a force on the fluid. An extended DEM model based on Newton's law of motion is used to represent the interaction among the particles and between the particles and the fluid, following the work of [2]. For the latter effect, the fluid field is evaluated in a consistent way at the position of each particle in each time step.

The insights of this high-resolution model are used to extend and assess a mixture-model in order to increase the simulation quality compared to currently available mixture-model approaches and at much lower costs compared to fully resolved simulations. In fact, millions of particles are taken in account in order to show the efficiency of the model. This work is also oriented to study the quantitative assessment and towards validation.

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