FINITE ELEMENT MODEL OF GRAINS/FLUID FLOWS

Jonathan Lambrechts¹*, Jean-François Remacle² and Frédéric Dubois³

¹ Université catholique de Louvain, Institute of Mechanics, Materials and Civil Engineering, jonathan.lambrechts@uclouvain.be
² Université catholique de Louvain, Institute of Mechanics, Materials and Civil Engineering, jean-francois.remacl@uclouvain.be
³ Université de Montpellier 2, Laboratoire de Mécanique et de Génie Civil, Frederic.Dubois@univ-montp2.fr

Key words: finite element, contact dynamics, fluid-grains mixture

We present a model to solve grains/fluid flows. Mixtures of grains and fluids occur in a large number of industrial and geophysical applications like fluidised beds, mixing, mudflows, landslides, submarine avalanches, etc.

The granular phase is solved by a contact dynamics method at the particle scales. For the hydrodynamic part, we solve the incompressible Navier-Stokes-Brinkman equations in a porous media by a finite element method. Those equations represent in a single model a continuous transition between the Darcy regime at high particle concentration and a classical Navier-Stokes flow at low concentration. At high Reynolds number, the term of Forchheimer is used to take the particle shapes into account. This approach allows the simulation of a granular phase with a large number of particles with different size, shape, and compactness.

The interactions between the grains and the fluid mixture occurs at a mesoscopic scale. The mesoscopic scale is chosen independently of the mesh resolution of the hydrodynamic problem so that the flexibility of the unstructured mesh is fully preserved. A mesh convergence analysis is performed and, thanks to a proper treatment of the coarse-graining and projection operations, the order of precision of the finite-element method is preserved.

REFERENCES
