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FEM techniques for multiphase flow problems

This talk deals with FEM discretization techniques and fast solvers for multiphase flow problems which are based on the incompressible Navier-Stokes equations. Our main emphasis will be on liquid-solid configurations ("many rigid objects of different shape and size which interact with the surrounding fluid"), and direct numerical simulation techniques based on the fictitious boundary method (FBM) are presented. The flow is computed by a multigrid finite element solver (FEATFLKOW) and the solid particles are allowed to move freely through the computational mesh which can be chosen independently from the particles of arbitrary shape, size and number. The interaction between the fluid and the particles is taken into account by the FBM in which an explicit volume based calculation for the hydrodynamic forces is integrated. A new collision model based on papers by Glowinski, Joseph, Singh and coauthors is examined to handle particle-particle and particle-wall interactions. Numerical tests show that the present method provides a very efficient approach to simulate particulate flows with many particles.