DISTRIBUTED LAGRANGE MULTIPLIER-BASED FICTITIOUS DOMAIN METHODS FOR THE NUMERICAL SIMULATION OF PARTICLE FLOW

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In this presentation, we will discuss the application of domain embedding methods of the fictitious domain type to the numerical simulation of incompressible viscous flow, possibly non-Newtonian, in two- or three-dimensional space regions with moving rigid boundaries. The resulting methodology will be applied to the direct numerical simulation of particulate flow concerning mixtures of incompressible viscous fluids and rigid solid particles of various shapes.

The computational techniques rely on a combination of::

1. Finite element approximation.
2. Distributed Lagrange multiplier-based fictitious domain methods.
3. Time discretization by operator-splitting.
4. Wave-like equation treatment of the advection.
5. Projection methods for treatment of the incompressibility.
6. Well-chosen repulsion potential for the treatment of collision or near-collision.

The above methodology will be validated by various numerical experiments concerning two- and three-dimensional flow regions and number of particle varying from one to many thousand; a particular attention will be given to the simulation of fluidization and sedimentation phenomena. Comparison with experimental data from laboratory measurements will be also presented.