A FAST PARALLEL ALGORITHM FOR DIRECT SIMULATION OF PARTICULATE FLOWS USING CONFORMING GRIDS

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This study presents a development of the direction splitting algorithm for problems in complex geometries proposed in [1] to the case of flows containing rigid particles. The main novelty of this method is that the grid can be very easily fit to the boundaries of the particle and therefore the spatial discretization is very accurate. This is made possible by the direction splitting algorithm of [1]. It factorizes the parabolic part of the operator direction wise and this allows to discretize in space each of the one-dimensional operators by adapting the grid to fit the boundary only in the given direction. Here we use a MAC discretization stencil but the same idea can be applied to other discretizations. Then the equations of motion of each particle are discretized explicitly and the so-computed particle velocity is imposed as a Dirichlet boundary condition for the momentum equations on the adapted grid. The pressure is extended within the particles in a fictitious domain fashion.

Finally, the presentation will demonstrate the accuracy and stability of the method on various benchmark problems involving rigid particles (see [2]). In addition, some results of direct simulations of fluidized beds involving thousands and millions of particles will be presented. Further details of these simulations can be found in [3].

References

[1] Ph. Angot, J. Keating, and P. Minev. A direction splitting algorithm for incompressible flow in complex geometries. *Comput. Methods Appl. Mech. Engrg*, 117:111–120, 2012.

[2] J. Keating and P. Minev. A fast algorithm for direct simulation of particulate flows using conforming grids. *J. Comp. Phys.*, 255:486–501, 2013.

[3] John William Keating. *Direction-splitting schemes for particulate flows*. PhD thesis, University of Alberta, Edmonton, 2013. http://hdl.handle.net/10402/era.33972.

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