Computational Mathematics Seminar Series

A Fast Parallel Algorithm for Direct Simulation of Particulate Flows Using Conforming Grids

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Lockett Hall 233
February 18, 2014 - 03:30 pm

Abstract:

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 □ctitious domain fashion.

The presentation will also include some results on direct simulations of fluidized beds involving thousands and millions of particles.

Speaker's Bio:

Peter D. Minev is a professor in the Department of Mathematical and Statistical Sciences at the University of Alberta, Canada. He earned his MSc and PhD from Sofia, Bulgaria. Dr. Minev's area of specialization is large scale computing for problems in science and engineering. It includes the development, analysis and implementation of numerical algorithms for the incompressible Navier-Stokes equations, average multiphase flow models, free boundary problems, fluid-structure interaction, MHD and non-isothermal flows.

His research interests can be summarized as follows.

- Fictitious domain methods for fluid-structure interaction problems.
- Finite element methods for free boundary problems.
- Finite element, spectral and spectral element methods for fluid flow and heat transfer problems.
- Lagrangian and Eulerian-Lagrangian algorithms using finite elements.
- Projection methods for the incompressible Navier-Stokes equations.
- Numerical methods for MHD.
- Preconditioned iterative methods for linear algebraic systems.
- DNS/LES of transition to turbulence in free and forced convection flows.
- Mathematical modelling of multiphase flows.
- Scientific computing/supercomputing; parallel algorithms for the finite element method.