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# Proteus: a New Computational Method for Multiphase Flow

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“Proteus” is a new computational scheme that combines several desired components of the Lattice Boltzmann Method (LBM) the Immersed Boundary Method (IBM) and the Direct Forcing Method (DFM) in order to solve fluid-particle interaction problems, including problems with deformable boundaries. The method uses a regular Eulerian grid for the flow domain and a Lagrangian grid to follow particles in the flow field. The velocity field of the fluid and particles is solved by adding a force density term into the LBM. The no-slip condition on the boundary of a moving particle is enforced by adding a forcing term in the momentum equations as in the case of the IBM. “Proteus” applies the direct forcing scheme and eliminates the need for the determination of the stiffness coefficient, a free parameter that requires trial and testing to select. This allows the enforcement of the rigid body motion of a particle in a more direct and efficient way. This novel method preserves the advantages of LBM in tracking a group of particles and, at the same time, provides an alternative and better approach to treating the solid-fluid boundary conditions. Proteus enables one to simulate problems with particle deformation and fluid-structure deformation. Here we present results on the validation of the method as well as the solution to a problem with 1234 spheres in an enclosure.

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