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An improved fictitious domain method for simulating sediment rigid particles in viscous fluid

S.F.Wu, *L.Yuan

Institute of Computational Mathematics, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Zhong Guan Cun East Road 55, Beijing 100190, China

*Corresponding author: lyuan@lsec.cc.ac.cn

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A fictitious domain–based method for numerical simulation of fluid flow with many solid bodies is developed and a new strategy for particle-particle collision is presented. In earlier methods, a repulsive force is applied to particles when their separation distance is less than a critical value, and depending on the magnitude of this repulsive force, collision of two or more particles may bounce unrealistically. In the present method, when the collision happens, a direct force is added to each particle by using Discrete Element Method (DEM) for particle collision. A direct-forcing fictitious domain method (DF-FDM) is applied to simulate multi-particle fluid flows. The forcing terms is obtained via discrete delta function in the form of bi-function to transfer quantities between Eulerian and Lagrangian nodes as in the immersed boundary method. This direct forcing avoids the need to use Lagrange multipliers for imposition of the rigid body motion as done in earlier FDM. Numerical results for the motion of several particles in a viscous fluid are presented.