Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Influence of lubrication forces in direct numerical simulations of particle-laden flows[1] ROHIT MAITRI, FRANK PETERS, JOHAN PADDING, HANS KUIPERS, Eindhoven Univ of Tech — Accurate numerical representation of particle-laden flows is important for fundamental understanding and optimizing the complex processes such as proppant transport in fracking. Liquid-solid flows are fundamentally different from gas-solid flows because of lower density ratios (solid to fluid) and non-negligible lubrication forces. In this interface resolved model, fluid-solid coupling is achieved by incorporating the no-slip boundary condition implicitly at particles surfaces by means of an efficient second order ghost-cell immersed boundary method. A fixed Eulerian grid is used for solving the Navier-Stokes equations and the particle-particle interactions are implemented using the soft sphere collision and sub-grid scale lubrication model. Due to the range of influence of lubrication force on a smaller scale than the grid size, it is important to implement the lubrication model accurately. In this work, different implementations of the lubrication model on particle dynamics are studied for various flow conditions. The effect of a particle surface roughness on lubrication force and the particle transport is also investigated. This study is aimed at developing a validated methodology to incorporate lubrication models in direct numerical simulation of particle laden flows.

[1]This research is supported from grant 13CSER014 of the Foundation for Fundamental Research on Matter (FOM), which is part of the Netherlands Organisation for Scientific Research (NWO).

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Date submitted: 30 Jul 2016 Electronic form version 1.4