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Numerical simulation of suspensions: taking close interactions into account

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We address the problem of numerical simulation of suspensions of rigid particles in a Stokes flow. We focus on the inclusion of the singular short range interaction effects (lubrication effects) in the simulations when the particles come close one to another. Taking into account these lubrication effects in numerical simulations is a difficult problem: capturing the singularity requires, for example, the use of very fine meshes in the gap between the particles.

We describe here two methods allowing to take into account lubrication without mesh refinement. The first one is based on an asymptotic development of the solution in the narrow gap between the particles. It allows to obtain accurate results with classical direct methods (finite elements,...) for coarse meshes, without adding new assumptions or new models. We will then describe a second method, based on a viscous contact model. This new contact model, coupled with a fluid solver, allows a good consideration of the effects of lubrication (which are not captured by the solver for coarse meshes).

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