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CONTACT AVOIDING FOR RIGID PARTICLES IN A STOKESIAN FLUID

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Using a boundary integral formulation of the Stokes equations, the hydrodynamic interactions between rigid particles immersed in a viscous fluid can be accurately computed. As particles get closer, however, their interactions become increasingly difficult to accurately resolve. Lubrication forces between particles, which physically guarantee no-collision, can be resolved only using high spacial discretisation of the particle surfaces and insufficient treatment of close interactions can in the worst case lead to non-physical particle overlaps. We avoid such collisions by robustly introducing artificial repulsion forces to the system that still allows for computations of the particle interactions to a desired accuracy.

Particles are considered to be in contact if they are closer to each other than a prescribed distance for which the particle-particle interaction can be accurately resolved. For each time-step, the contact force magnitudes for colliding particles can be computed as the solution to a complementarity problem. The linearised complementarity problem is approximated by treating collisions between particles separately for each pair to reduce the cost of the multi-particle coupling trough the fluid. Two different strategies are compared, where the collision is described either using the signed distance between points on the particle boundaries [2], or as the so called Space Time Interference Volume [1]. The conservation of the reversibility of the Stokes flow and the ability of guaranteeing non-overlapping particles in long time-scale simulations are of special interest, but also contact force magnitudes and work per time-step are studied for various background flows and particle configurations.

REFERENCES

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