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Hydrodynamic forces between colliding spheres during mechanical contact JULIAN SIMEONOV, Naval Research Laboratory — The time-dependent Stokes equations are solved in the gap of O(1 mm) colliding spheres to determine the rate of change of the lubrication forces after the onset of mechanical contact and large deceleration. Mechanical contact is assumed to begin when the gap clearance becomes equal to the size of the O(0.1 micron) micro-asperities present on the surface of real particles. Fourier expansion is used to solve the initial value problem. Assuming small gap clearances, the leading order asymptotic solution is obtained using singular perturbation expansion methods to match the viscous gap solution and the outer inviscid solution. The asymptotic solution provides the dependence of the resistance, added mass and history forces on the sphere velocity, sphere acceleration, the micro-asperity size and the ratio of the sphere diameters. The analytical results can be used to improve the modeling of hydrodynamic forces during mechanical contact in simulations of particle-laden flow or acoustic propagation in fully saturated sediments.

Julian Simeonov
Naval Research Laboratory

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