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Multiple Particle Interaction at Intermediate Reynolds Numbers

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The literature is rich with studies on particle interaction in Stokes flow. However, there are scant studies on particle interaction at intermediate Reynolds numbers. Here, we present a new computational scheme to simulate the dynamics of the particles coupled to the Naviers-Stokes solutions for the fluid. In order to understand the basic picture of particle-particle interactions in fluid, we investigate the dynamics of an array of freely falling cylinders with an initial spacing on the order of the particle diameter. We find that for a small number of particles ($n = 3,\ 4$), there are two distinct falling configurations which depend on the parity of n. For $n > 4$, the falling configuration is a mix of those previous modes. However, when the initial spacing between particles is below a threshhold, the array is separated into small clusters of 2 or 3 particles. We further quantify the interaction force between two falling particles as a function of their relative position, and compare them with results in the Stokes regime.

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