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Mean and Fluctuating Force Distribution in a Random Array of Spheres[1] GEORGES AKIKI, THOMAS JACKSON, SIVARAMAKRISHNAN BALACHANDAR, Univ of Florida - Gainesville — This study presents a numerical study of the force distribution within a cluster of mono-disperse spherical particles. A direct forcing immersed boundary method is used to calculate the forces on individual particles for a volume fraction range of [0.1, 0.4] and a Reynolds number range of [10, 625]. The overall drag is compared to several drag laws found in the literature. As for the fluctuation of the hydrodynamic streamwise force among individual particles, it is shown to have a normal distribution with a standard deviation that varies with the volume fraction only. The standard deviation remains approximately 25% of the mean streamwise force on a single sphere. The force distribution shows a good correlation between the location of two to three nearest upstream and downstream neighbors and the magnitude of the forces. A detailed analysis of the pressure and shear forces contributions calculated on a ghost sphere in the vicinity of a single particle in a uniform flow reveals a mapping of those contributions. The combination of the mapping and number of nearest neighbors leads to a first order correction of the force distribution within a cluster which can be used in Lagrangian-Eulerian techniques. We also explore the possibility of a binary force model that systematically accounts for the effect of the nearest neighbors.

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