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An asymptotic analysis of particle clustering in turbulent flows
MAHDI ESMAILY MOGHADAM, ALI MANI, Stanford Univ — Interaction of dense inertial particles with turbulent flow is analysed. An asymptotic solution is obtained that quantifies particle clustering on a wide range of Stokes numbers and flow conditions. In a simplified form, particle clustering is predicted to be $St/(St^2+1)$, in which St is the Stokes number based on the Kolmogorov time scale, hence predicting maximum clustering at $St = 1$ and first order decay of clustering as $St \to 0$ and ∞. These results are validated against numerical simulation of inertial particles in a homogeneous isotropic turbulent flow. This comparison shows excellent prediction of our analysis at all Reynolds and Stokes numbers with a slight under-prediction when both Reynolds and Stokes numbers are high. The important role of Kolmogorov scale on particle clustering is confirmed by our analysis.

Mahdi Esmaily Moghadam
Stanford Univ

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