Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Effect of ambient flow inhomogeneity on forces on a finite-sized particle[1] JUNGWOO KIM, S. BALACHANDAR, University of Florida — In particle-laden flows involving particle transport and dispersion, the prediction of forces acting on the particle in a nonuniform flow is one of the central issues. However, existing analytical expressions and empirical correlations have been mostly developed for uniform or other simple linear ambient flows. Therefore, in this study we perform direct numerical simulations of a finite-sized spherical particle in a cellular flow field in order to improve knowledge concerning the influence of the spatial flow-variations on the forces acting on the particle in more general flows. To do so, the ratio of the particle diameter (D) and the cell size in the cellular flow (L) is varied in the range of $0.01 \leq D/L \leq 0.2$. In this study, the instantaneous drag force is separately considered as quasi-steady and unsteady components. Then, each force component is compared with existing expressions for the corresponding force on the particle. The present study shows that in the presence of the spatial variations, the effect of flow inhomogeneity on the quasi-steady drag appear to be larger than what is predicted by the Faxen correction derived in creeping flow. These results are used in our understanding of forces on a finite-sized particle in turbulent flows.

[1]We acknowledge NSF CBET0639446.

S. Balachandar
University of Florida

Date submitted: 30 Jul 2008 Electronic form version 1.4