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Particle-Resolved Direct Numerical Simulation of a Particle-Laden Mixing Layer[1] MOHAMMAD MEHRABADI, Iowa State University, SUDHEER TENNETI, Now at CD-Adapco, SHANKAR SUBRAMANIAM, Iowa State University — The stability of a homogeneous gas-solid suspension has been investigated in the context of kinetic theory (Koch, Phys. Fluids, 1990) and the averaged two-fluid equations (Glasser et al, PRL, 1998) by considering perturbation of the number density. Koch's analysis points to the dependence of average drag on average volume fraction as the mechanism for the development of instabilities in the number density. However, the physical origins of instabilities in the number density have not been firmly established through microscale simulations at the scale of individual particles. In this study, particle-resolved direct numerical simulation (PR-DNS) is used to ascertain the exact physical origins of the growth of number density instabilities in a particle-laden mixing layer. Self-similarity of the temporally evolving number density profile, and the diffusive/convective nature of the instability is examined to ascertain the role of granular temperature in instability growth. The growth of streamwise and cross-stream structures in the particle field are analyzed to draw analogies with the classical Rayleigh-Taylor and Kelvin-Helmholtz instability mechanisms.

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