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Role of fluctuations in instability generation in gas-solid suspensions[1] SHANKAR SUBRAMANIAM, MOHAMMAD MEHRABADI, RAVI KOLAKALURI, SUDHEER TENNETI[2], Iowa State University — Stability analysis of gas-solid suspensions using kinetic theory (Koch, Phys. Fluids, 1990) relies on a number density function (NDF) that is based on the canonical (constant number) ensemble. Euler-Lagrange simulations of a model problem are used to show that this approach does not accurately represent the scale–dependent interphase coupling between different realizations of the gas velocity field and fluctuations in the number of particles naturally occurring in fluidized beds. The grand-canonical (or variable number) ensemble is better suited to representing this coupling, and it is shown how the NDF can be related to this ensemble. The evolution of the grand-canonical NDF then leads to instabilities and growth of spatial fluctuations in the number density of a homogeneous suspension. This analysis leads to a different explanation for the growth of instabilities in homogeneous gas-solid suspensions that does not require perturbations in the average number density. Rather it is shown that the interaction of different realizations of the gas velocity field with individual realizations of the particle field leads to the growth of instabilities due to the dependence of drag on local volume fraction in each realization, that is extracted from particle-resolved DNS data.

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Shankar Subramaniam
Iowa State University

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