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Examining the Equilibrium State in Lagrangian Particle Dynamics[1] MARIO F. TRUJILLO, University of Wisconsin, Madison, ALEX PARKHILL, The Pennsylvania State University — In a number of applications the particle size and flow conditions are such that to a great extent the motion of particles occurs under an equilibrium state, in which case the particle forces are practically in perfect balance. The exact conditions that lead particles into and out of this state are studied within the framework of Stokes drag and one-way momentum couple flows. It is shown that the primary parameter that governs deviation from equilibrium is the product of the particle time constant and the maximum eigenvalue of the velocity gradient tensor. This parameter is proposed as a redefinition of the Stokes number for particulate flow. The implications clearly indicate that traditional definitions of the particle Stokes number, which are generally represented by ratios of particle time constant and flow characteristic times are insufficient in providing a rigorous criterion for equilibrium. The new Stokes number's effectiveness in predicting departures from equilibrium is demonstrated mathematically and numerically. The conclusions derived are supported by simulations of particle transport in 2-D and 3-D analytical flow fields. The Lagrangian analysis presented here stands in contrast to earlier Eulerian formulations presented in the literature.

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