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GPU acceleration of Eulerian-Lagrangian particle-laden turbulent flow simulations[1] DAVID RICHTER, JAMES SWEET, DOUGLAS THAIN, University of Notre Dame — The Lagrangian point-particle approximation is a popular numerical technique for representing dispersed phases whose properties can substantially deviate from the local fluid. In many cases, particularly in the limit of one-way coupled systems, large numbers of particles are desired; this may be either because many physical particles are present (e.g. LES of an entire cloud), or because the use of many particles increases statistical convergence (e.g. high-order statistics). Solving the trajectories of very large numbers of particles can be problematic in traditional MPI implementations, however, and this study reports the benefits of using graphical processing units (GPUs) to integrate the particle equations of motion while preserving the original MPI version of the Eulerian flow solver. It is found that GPU acceleration becomes cost effective around one million particles, and performance enhancements of up to 15x can be achieved when $O(10^8)$ particles are computed on the GPU rather than the CPU cluster. Optimizations and limitations will be discussed, as will prospects for expanding to two- and four-way coupled systems.

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David Richter
University of Notre Dame

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