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Analysis and Comparison with DNS of a Stochastic Model for the Relative Motion of High-Stokes-Number Particles in Isotropic Turbulence ROHIT DHARIWAL, SARMA RANI, Univ of Alabama - Huntsville, DONALD KOCH, Cornell University — In an earlier work, Rani, Dhariwal, and Koch (JFM, Vol. 756, 2014) developed an analytical closure for the diffusion current in the PDF transport equation describing the relative motion of high-Stokes-number particle pairs in isotropic turbulence. In this study, an improved closure was developed for the diffusion coefficient, such that the motion of the particle-pair center of mass is taken into account. Using the earlier and the new analytical closures, Langevin simulations of pair relative motion were performed for four particle Stokes numbers, $St_\eta = 10,\ 20,\ 40,\ 80$ and at two Taylor micro-scale Reynolds numbers $Re_\lambda = 76,\ 131$. Detailed comparisons of the analytical model predictions with those of DNS were undertaken. It is seen that the pair relative motion statistics obtained from the improved theory show excellent agreement with the DNS statistics. The radial distribution functions (RDFs), and relative velocity PDFs obtained from the improved-closure-based Langevin simulations are found to be in very good agreement with those from DNS. It was found that the RDFs and relative velocity RMS increased with Re_λ for all St_η. The collision kernel also increased strongly with Re_λ, since it depended on the RDF and the radial relative velocities.

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