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Lagrangian velocity correlations in homogeneous and isotropic turbulence GUOWEI HE, GUODONG JIN, XIN ZHAO, LNM, Institute of Mechanics, Chinese Academy of Sciences — Lagrangian velocity correlations are the important quantity to describe turbulent diffusion processes and pose the challenges for modeling efforts that do not explicitly represent subgrid scale motions in large eddy simulation. Our previous study investigates the effects of subgrid scale modeling on Eulerian velocity correlations (Phys. Fluids.14 2186), where the Kraichnan model for Eulerian velocity correlations is crucial (Phys. Fluids 16 3859). The present study develops a model for Lagrangian velocity correlations in homogeneous and isotropic turbulence, which relates the Lagrangian velocity correlations to the Eulerian velocity correlations via a characteristic velocity. The characteristic velocity is analytically calculated from the Navier-Stokes equations and provides the decorrelation time scales. The model is based on the two assumptions on the iso-correlation contours: (1) they can be well approximated by the elliptic curves; (2) they are self-similar at sufficient large Reynolds numbers, that is to say, they share a preference directions and aspect ratios. The data from direct numerical simulation of homogeneous and isotropic turbulence verifies the the model. The model is further discussed on its relationship with Kraichnan's straining hypothesis and its potential applications to the large eddy simulation of particle-laden turbulence.

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