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Geometric nature of particle trajectory in isotropic turbulence
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Mathematical Science, CHANGHOON LEE, Yonsei University — The geometric na-
ture of particle trajectory is investigated for understanding the Lagrangian nature
of turbulence using direct numerical simulation of isotropic turbulence. Probability
density functions and autocorrelations along a fluid particle trajectory associated
with geometric quantities such as curvature and torsion of the Lagrangian trajec-
tory are provided. We propose the ratio of torsion to curvature as an important
parameter to identify the particle trajectory, and it is found to play a crucial role in
understanding the geometric shape of particle trajectory. The relationship between
Lagrangian helicity and the ratio of torsion to curvature is investigated where La-
grangian helicity is defined as a dot product of velocity and vorticity vectors at the
point of a fluid particle. We also found that probability density functions of torsion
and torsion normalized by curvature clearly show well-established slope in log–log
plots. Lagrangian helicity is intermittently distributed and high Lagrangian helicity
is always found, where high acceleration is observed. Regarding the relationship be-
tween coherent structure and acceleration, coherent structure can be understood in
terms of Lagrangian helicity, curvature, and torsion. Geometric characteristics for
solid particles are also investigated and its behavior differs depending on the Stokes
number.

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