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Multi-scale geometric analysis of Lagrangian structures in isotropic turbulence[1] YUE YANG, D.I. PULLIN, IVAN BERMEJO-MORENO, California Institute of Technology — The recently developed multi-scale methodology (see J. Fluid Mech. 603, 101-135, 2008) is applied to study the non-local geometry of finite-sized Lagrangian structures in forced isotropic turbulence. A particle backward-tracking method was first applied to obtain the Lagrangian scalar field ϕ governed by the pure advection equation. The temporal evolution of Lagrangian structures was obtained by extracting iso-surfaces of ϕ with resolution 1024^3. The multi-scale geometric analysis was then applied on the evolution of ϕ to extract structures at different length scales and to characterize their non-local geometry in a "visualization space" of reduced geometrical parameters. We observe an evolutionary breakdown of Lagrangian blobs that first distort and then stretch into sheets. Compared with the statistical geometry of instantaneous passive scalar and enstrophy fields in turbulence, Lagrangian structures tend to exhibit more prevalent sheet-like shapes at inertial-range and small scales. Furthermore, after a finite time, the evolutionary geometry of Lagrangian structures appears to be insensitive to the form of the initially smooth Lagrangian scalar field.

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