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Geometric study of Lagrangian and Eulerian structures in turbulent channel flow[1] YUE YANG, DALE PULLIN, California Institute of Technology — We report a geometric study of both evolving Lagrangian, and also instantaneous Eulerian structures in turbulent channel flow at $Re_\tau = 180, 395, 590$. The former are obtained by tracking a Lagrangian scalar field while the latter are extracted from the swirling-strength field at a time instant. A multi-scale and multi-directional analysis, based on the mirror-extended curvelet transform, is developed to quantify flow structure geometry including the averaged inclination and sweep angles of both classes of flow structure at up to seven scales. These range from the half-height of the channel to several viscous length scales. Here, the inclination angle is defined on the plane of the stream-wise and wall-normal directions, and the sweep angle on the plane of the stream-wise and span-wise directions. Results for turbulent channel flow include the geometry of candidate hairpin vortices and other structures in the near-wall region, the structural evolution of near-wall vortices, and evidence for the existence and geometry of hairpin packets based on statistical inter-scale correlations.

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