On the non-local geometry of turbulence\textsuperscript{1}  IVAN BERMEJO-MORENO, D.I. PULLIN, California Institute of Technology, KIYOSI HORIUTI, Tokyo Institute of Technology — A multi-scale methodology for the study of the non-local geometry of structures in turbulence is applied to a passive-scalar field and the square of the vorticity field of a 512\textsuperscript{3} periodic cube DNS of homogeneous isotropic turbulence. Results of its application to the vorticity field of a set of DNS with identical initial conditions and increasing grid resolutions (256, 512, 1024\textsuperscript{3}, with $k_{\text{max}}\eta \approx 1, 2, 4$) are also discussed. The methodology consists of three main steps: extraction, characterization and classification, starting from a 3D scalar field. Extraction is done via the curvelet transform (allowing a multi-scale decomposition), followed by isosurfacing of the set of scalar fields obtained by filtering in curvelet space. Characterization is based on the area-based probability density function of two differential-geometry properties, shape index and curvedness, complemented with global invariants of the surface, thus defining its signature. Classification uses a feature space of parameters obtained from the signature of each structure, where clustering techniques are applied searching for groups of structures with common geometry.

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