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Visualizing Orientation Fields of Fibers Advected in Turbulent and Chaotic Flows ANDREA MASI-PHELPS, BARDIA HEJAZI, Wesleyan Univ, BERNHARD MEHLIG, Gothenburg Univ, GREG A. VOTH, Wesleyan Univ
— We examine the spatial field of orientations of slender fibers in 3D turbulent and 2D chaotic fluid flows. The spatial field of fiber orientations is dominated by surfaces (in three dimensions) and lines (in two dimensions) across which the fiber orientation changes rapidly and approaches a step change of π. Using the JHU turbulence database of 3D homogeneous isotropic turbulence at $R_\lambda = 418$ and the standard map for 2D chaotic flow, we extract the Cauchy-Green strain tensors whose most extensional eigenvector gives the preferred orientation of fibers at a point in the flow. Visualization of the orientation field reveals the structure of the steps. We also study the moments of the relative orientation of two fibers as a function of the distance between the two points. We observe the anomalous scaling found by Zhao et al (arxiv:1707.06037) which reflects the fractal structure of the orientation field that results from the continuous formation of new steps in the orientation field.

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