Empirical estimates of local turbulent diffusivity coefficients from a sequence of images of a 2D passive scalar

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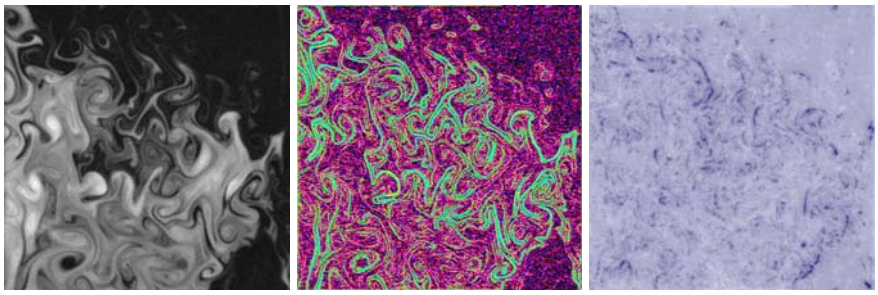
The study of turbulent diffusion of passive scalars has attracted the attention of researchers since long ago[6]. Turbulent diffusion is more important in the inertial range than its molecular conterpart, but it depends as a power law in the resolution scale[4,3]. Obtaining eddy diffusivity tensors is crucial for the correct modeling of many processes of interest for industry[2] and geophysics[1]. In this work we will explain a method to estimate global and local scalar turbulent diffusivities from sequences of images of a passive scalar (left panel). The method is based on the extraction of local singularity exponents[5], which are affected by a multifractal structure due to the highly turbulent character of the flow. The singularities themselves (central panel) can be proved to form a passive scalar, less affected by acquisition noise and long-correlation effects, thus more effective for estimating eddy diffusivities. A simple averaging technique gives access to the local diffusivity at each point (right panel). We observed a scaling dependence close to Kolmogorov's 4/3 exponent.



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