Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Multi-scale analysis of local flow topology in isotropic turbulence[1]

MOHAMMAD DANISH, Johns Hopkins University, US (now at Bennett University, India), CHARLES MENEVEAU, Johns Hopkins University, US — Knowledge of local flow-topology, as described by the velocity gradients, is useful to develop insights of turbulence processes, such as energy cascade, material element deformation, etc. Much has been learned in recent past about flow-topology at the smallest (viscous) scales of turbulence. However, less is known at larger (or inertial) scales of turbulence. In this work, we present a detailed study on the scale-dependence of various quantities of our interest, like population fraction of different flow-topologies, joint probability distribution of second and third invariants of velocity gradient tensor, etc. We use a new filter proposed by Eyink & Aluie to decompose the flow into small and large scales. We provide further insights for the observed behavior of scale-dependence by examining the probability fluxes appearing in the Fokker-Plank equation. Specifically, we aim to understand whether the differences observed between the viscous and inertial range are due to different effects caused by pressure, subgrid-scale or viscous stresses, or various combination thereof. For this purpose, we use the isotropic turbulence dataset at $Re_\lambda = 433$ available at JHTDB and the analysis tools developed for SciServer, including FFT to evaluate filtering and gradients.

[1]Supported by the National Science Foundation (Grants No. 1507469 and 1633124).

Mohammad Danish
Johns Hopkins University (now at Bennett University, India)

Date submitted: 31 Jul 2017 Electronic form version 1.4