Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Area of Scalar Isosurfaces in Homogeneous Isotropic Turbulence[1]

KEDAR PRASHANT SHETE, STEPHEN DE BRUYN KOPS, University of Massachusetts Amherst — A fundamental effect of fluid turbulence is turbulent mixing, which results in the stretching and wrinkling of scalar isosurfaces. Thus, the area of isosurfaces is of interest in understanding turbulence in general with specific applications in, e.g., combustion and the identification of turbulent/non-turbulent interfaces. We report measurements of isosurface areas in 28 direct numerical simulations (DNSs) of homogeneous isotropic turbulence with a mean scalar gradient resolved on up to 14256^3 grid points with Taylor Reynolds number Re ranging from 24 to 633 and Schmidt number Sc ranging from 0.1 to 7. The continuous equation we evaluate converges exactly to the area in the limit of zero layer thickness. We demonstrate a method for numerically integrating this equation that, for a test case with an analytical solution, converges linearly towards the exact solution with decreasing layer width. By applying the technique to DNS data and testing for convergence with resolution of the simulations, we verify the resolution requirements for DNS that have been recently published. We conclude that isosurface areas scale with the square root of the Taylor Péclet number Pe between approximately 50 and 4429. No independent effect of either Re or Sc were observed.

[1]Frontier Project FP-CFD-FY14-007

Kedar Prashant Shete
University of Massachusetts Amherst

Date submitted: 26 Jul 2019 Electronic form version 1.4