Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

An explicit filtering framework based on Perona-Malik anisotropic diffusion for shock capturing and subgrid scale modeling of Burgers' turbulence ROMIT MAULIK, OMER SAN, Oklahoma State University - Stillwater — In this work, we introduce a relaxation filtering closure approach to account for subgrid scale effects in explicitly filtered large eddy simulations using the concept of anisotropic diffusion. We utilize the Perona-Malik diffusion model and demonstrate its shock capturing ability and spectral performance for solving the Burgers turbulence problem, which is a simplified prototype for more realistic turbulent flows showing the same quadratic nonlinearity. Our numerical assessments present the behavior of various diffusivity functions in conjunction with a detailed sensitivity analysis with respect to the free modeling parameters. In comparison to direct numerical simulation (DNS) and under-resolved DNS results, we find that the proposed closure model is efficient in the prevention of energy accumulation at grid cut-off and is also adept at preventing any possible spurious numerical oscillations due to shock formation under the optimal parameter choices. In contrast to other relaxation filtering approaches, it is also shown that a larger inertial range can be obtained by the proposed anisotropic diffusion model using a compact stencil scheme in an efficient way.

Romit Maulik
Oklahoma State University - Stillwater

Date submitted: 03 Aug 2016 Electronic form version 1.4