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Statistics of the Navier–Stokes-alpha-beta regularization model for fluid turbulence

We explore one-point and two-point statistics of the Navier–Stokes-alpha-beta regularization model at moderate Reynolds number in homogeneous isotropic turbulence. The results are compared to the limit case of the Navier–Stokes-alpha regularization model and high resolution direct numerical simulation (DNS) results. After reviewing spectra of different energy norms of the Navier–Stokes-alpha and Navier–Stokes-alpha-beta model, we present probability density functions (PDFs) and normalized PDFs of the filtered and unfiltered velocity increments as well as longitudinal velocity structure functions of both regularization models and DNS results. We highlight differences in the statistical properties of the unfiltered and filtered velocity fields entering the governing equations of the regularization models and discuss the usability of both velocity fields for realistic flow predictions. The filtered velocity field is found to have physically more viable PDFs and structure functions for the approximation of DNS results, whereas the unfiltered velocity field is found to have flatness factors close to DNS results. This is joint work with Tae-Yeon Kim and Eliot Fried.