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Alignments and small scale statistics in the production region of grid turbulence IMMANUVEL PAUL, GEORGE PAPADAKIS, JOHN CHRISTOS VASSILICOS, Department of Aeronautics, Imperial College London, TURBULENCE, MIXING AND FLOW CONTROL GROUP TEAM — Direct Numerical Simulation (DNS) of turbulent flow generated by a single square grid is investigated using an unstructured finite volume method. The maximum value of the Taylor length-based Reynolds number throughout the computed flow field is about 40. The main focus of this study is on the production region which lies in the lee of the grid where turbulence builds up. Statistics of vorticity and of eigenvalues (λ_i, where i=1,2,3) and eigenvectors (e_i, where i=1,2,3) of the fluctuating strain rate tensor (S_{ij}) are analyzed. It is observed that the PDFs of all the eigenvalues in the production region are highly non-gaussian. The PDFs of the compressive (λ_3) and intermediate (λ_2) eigenvalues are strongly skewed to negative and positive values respectively. The energy spectrum of the streamwise fluctuating velocity has a well-defined power law with an exponent around -2 or -5/3 over more than one decade depending on the position in the production region. It is also observed that the most extensive eigenvector (e_1) and the intermediate eigenvector (e_2) align significantly with vorticity vector in the production region, which in turn increases average enstrophy production.

Immanuvel Paul
Imperial College London

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