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Analysis of Lagrangian stretching in turbulent channel flow using a database task-parallel particle tracking approach[1] CHARLES MENEVEAU, PERRY JOHNSON, STEPHEN HAMILTON, RANDAL BURNS, Johns Hopkins University — An intrinsic property of turbulent flows is the exponential deformation of fluid elements along Lagrangian paths. The production of enstrophy by vorticity stretching follows from a similar mechanism in the Lagrangian view, though the alignment statistics differ and viscosity prevents unbounded growth. In this paper, the stretching properties of fluid elements and vorticity along Lagrangian paths are studied in a channel flow at $Re_\tau = 1000$ and compared with prior, known results from isotropic turbulence. To track Lagrangian paths in a public database containing Direct Numerical Simulation (DNS) results, the task-parallel approach previously employed in the isotropic database is extended to the case of flow in a bounded domain. It is shown that above 100 viscous units from the wall, stretching statistics are equal to their isotropic values, in support of the local isotropy hypothesis. Normalized by dissipation rate, the stretching in the buffer layer and below is less efficient due to less favorable alignment statistics. The Cramér function characterizing cumulative Lagrangian stretching statistics shows that overall the channel flow has about half of the stretching per unit dissipation compared with isotropic turbulence.

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