Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Direct Numerical Simulation and Coherent Vortex Extraction of sheared and rotating turbulent flow L. LIECHTENSTEIN, K. SCHNEIDER, M2P2-CNRS & CMI, Aix-Marseille University, F.G. JACOBITZ, Mechanical Engineering Program, University of San Diego, M. FARGE, LMD-CNRS, Ecole Normale Superieure — The effect of rotation on the structure and dynamics of homogeneous sheared turbulence is investigated using direct numerical simulation (PoF, 20, 045103 (2008)). We consider shear flow without rotation, with moderate and with strong rotation, where the rotation axis is either parallel or anti-parallel to the mean flow vorticity. For moderate rotation an anti-parallel configuration increases the growth of the turbulent kinetic energy for a limited range of rotation ratios, while the parallel case reduces the growth as compared to the non-rotating case. For strong rotation energy decay is observed and linear effects dominate. Flow visualizations show that the inclination angle of vortical structures depends on the rotation rate and orientation and that the inclination angle is related to the growth of the turbulent kinetic energy. Coherent vortex extraction, based on the orthogonal wavelet decomposition of vorticity, is applied to split the flow into coherent and incoherent parts. The coherent part preserves the vortical structures using only a few percent of the degrees of freedom, while the incoherent part was found to be structureless and of dissipative nature. With increasing rotation rates, the number of wavelet modes representing the coherent vortices decreases, indicating an increased coherency of the flow. Restarting the DNS with the filtered fields confirms that the coherent component preserves the temporal dynamics of the total flow.

Kai Schneider
M2P2-CNRS & CMI, Aix-Marseille University, Marseille, France

Date submitted: 03 Aug 2008 Electronic form version 1.4