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Hierarchical Structure of Fast Stretching Vortices in Turbulent Flows MASATO HIROTA, YU NISHIO, SEIICHIRO IZAWA, YU FUKUNISHI, Tohoku University — Geometric relations between fast stretching vortices of a certain scale and vortices twice larger are investigated to understand the energy cascade process in a turbulent flow from a view point of vortex interactions. Multi-scaled vortices are extracted from a homogeneous isotropic turbulence using a band-pass filter based on the Fourier decomposition. An extracted vortex is reconstructed as a set of short cylindrical vortex segments. The stretching speed of a vortex segment, caused by the velocity field, which vortices twice the scale generate, is measured. Then, the vortex segments are classified into the three categories by their stretching speeds: The first is the "super fast" stretching vortices, whose stretching speed is in top 1% of total segments. The second is "moderately fast" stretching vortices, whose stretching speed is in top 10% of total segments. The third is "slowly or not" stretching vortices, whose stretching speed is lower than the top 10%. The geometric relations between the vortex segments and its surrounding vortices which are larger are analyzed in terms of the distances and the relative angles. The result shows that vortex segments tend to be aligned parallel or anti-parallel to the larger vortices for the "slowly or not" stretching vortices. For the "super fast" stretching vortices, it is found that they tend to be orthogonal to the vortices of double size. Meanwhile, no particular tendency is found for the "moderately fast" stretching vortices.

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