Geometry and life time of the intense vorticity structures in isotropic turbulence

Afonso A. Ghira[1], Gerrit E. Elsinga[2] and Carlos B. da Silva[1]

[1] IST, ULisboa, [2] TU Delft

One of the most interesting features of turbulent flows consists in the presence of a large number of eddies, or 'worms' defined loosely as regions of concentrated vorticity, and low pressure, exhibiting spatial coherence over a relatively long time. In the present work we analyse the characteristics and temporal evolution of these structures using direct numerical simulations (DNS) of statistically stationary (forced) homogeneous isotropic turbulence (HIT).

The time tracking of the 'worms' identified both events of splits (where one 'worm' is fragmented into two or more new structures) and events of merger (where one or more structures merges into a new structure). As expected in statistically stationary turbulence the number of identified worms is approximately constant, which implies that the number of births (when a new structure arises in the flow) roughly balances the number of deaths (when a structure is dissipated). However, the results from several DNS carried out at different Reynolds numbers show that the majority of existing 'worms' 'die alone' without being involved in either 'splits' or merger events. Moreover, preliminary results seem to show that the mean life time of a 'worm' is equal to a few Kolmogorov time scales, suggesting that long lived structures, with life times of the order of the integral time scale, are relatively rare.