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Toward investigation of local vortex line topology in turbulence BAJRANG SHARMA, RISHITA DAS, SHARATH GIRIMAJI, Texas A&M University — Current vortex identification methods employ Q or λ_2 criterion to investigate vortical structures in turbulent flows. We propose an alternate method to examine the local vortex structure. Specifically, we construct the vorticity vector field ($\vec{\omega}$) and compute the vorticity gradient tensor ($J_{ik} \equiv \partial\omega_i/\partial x_k$). The tensor ($J_{ik}$), similar to the velocity gradient tensor ($A_{ij} \equiv \partial u_i/\partial x_j$), is trace free. In a manner similar to streamline topology analysis using the second and third invariants of A_{ij}, the second (Q_ω) and third (R_ω) invariants of J_{ik} are used to develop the topological description of local vortex line structure. Such a representation is not only useful for investigation of the local vortex-line structure but is also useful in identifying key turbulence phenomena such as vortex line reconnection. Direct numerical simulation (DNS) data of incompressible forced isotropic turbulence and perturbation-evolution in plane-Poiseuille flow are analysed in this study. We investigate the following: (i) distribution in these two key canonical turbulent flows; and (ii) the formation of hair-pin vortices in transitioning plane Poiseuille flow using the aforementioned method.

Bajrang Sharma
Texas A&M University

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