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Vortex sheet identification method and fourth-order velocity derivative invariants KIYOSI HORIUTI, Dept. Mechano-Aerosp. Eng., Tokyo Institute of Technology, YOHEI TAKAGI, TAKEHARU FUJISAWA — We considered a new identification method for vortex sheet structures in turbulent flows using the eigenvalue $[A_{ij}]_+$ of the tensor $A_{ij} \equiv (S_{ik}\Omega_{kj} + S_{jk}\Omega_{ki})$, where S_{ij} is the strain-rate tensor, Ω_{ij} the vorticity tensor. Effectiveness of the proposed method was verified in the assessment using DNS data for homogeneous isotropic turbulence. The region identified using the proposed method exhibited a characteristic feature consistent with that of the vortex sheet, i.e., comparable dominance of both strain rate and vorticity. As a result, intense dissipation took place in the educed region. The fractal dimension, D, of the individual structures with large amplitudes of $[A_{ij}]_+$ was $D \simeq 1.7$, with very little dependence on the threshold. This value indeed suggests structures in the form of vortex sheet, and was close to the fractal dimension of intense dissipation structures. The vortex sheets were spanned approximately by the two eigenvectors corresponding to other eigenvalues of A_{ij}, $[A_{ij}]_z$ and $[A_{ij}]_-$. Relationship between the eigenvalue $[A_{ij}]_+$ and the four invariants of fourth-order moments of velocity derivatives, I_i (Siggia 1981), was examined. It was shown that $[A_{ij}]_+ \simeq \sqrt{\frac{1}{2}A_{ij}A_{ji}} = \sqrt{\frac{1}{2}(I_2 - \frac{3}{2}I_3)}$. DNS data showed that the invariant, $A_{ij}A_{ji}$, deviated markedly from the Gaussian value, indicating that both the strain rate and vorticity in the region educed using $[A_{ij}]_+$ were strongly correlated, and both were highly intermittent.

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