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Research data supporting
"The evolution of coherent vortical structures in increasingly turbulent stratified shear layers"

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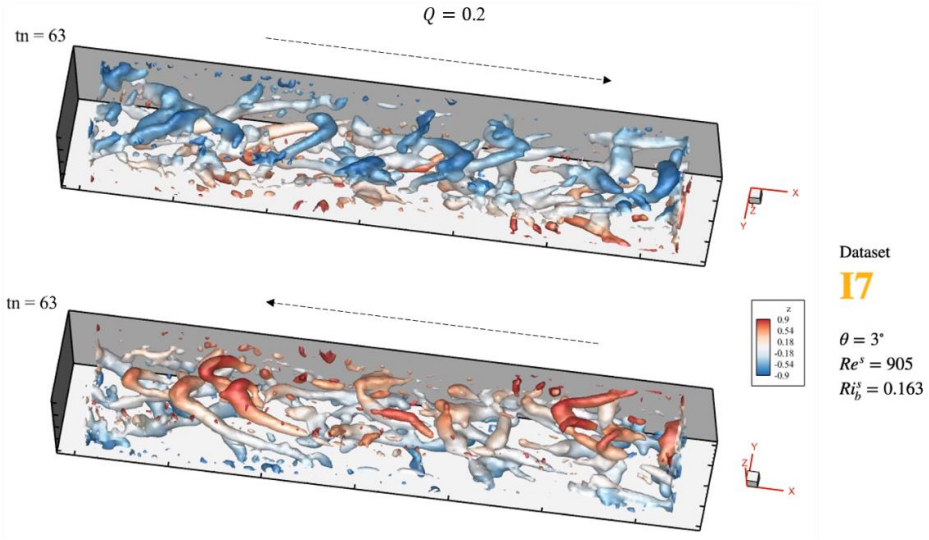
0. Data sets

We provide the 15 shear-layer rescaled and cropped data sets containing the **shear vector** ($\boldsymbol{Sv}$) and **rortex vector** ($\boldsymbol{Rv}$) based on the SID experiments**:** L1_RSvec.mat, H1_RSvec.mat, H2_RSvec.mat,…, T3_RSvec.mat. They are given in the Matlab format *.mat* and contain the variables $\boldsymbol{Sv}$ and $\boldsymbol{Rv}$ (5-D single-precision arrays). These datasets were generated from those available in [1]. The original datasets H1, H2, …, T3 containing the 3-D velocity field u, v, w, the density field r, and the axes x, y, z, t can be downloaded from [1].

The size of all data sets is *I*×*J*×*K*×3×*nT*, where *I*, *J*, *K* and *nT* are the length of the 1-D array x, y, z and t, respectively. The fourth dimension is for the three components of the vector along x, y, z respectively.

1. Movies

All the movies are in .mp4 format in 1920×1080 pixel resolution.



Movie 1 (example above) show the evolution of hairpin vortices based on the *Q*-criterion for I6, I7, I8, T1, T2 and T3, corresponding to figure 1*(e-j)* in the paper. The two panels show different perspectives at the same time. The top panel is viewed from the negative z direction (for better visualization of the lower-layer structures), while the bottom panel is viewed from positive z direction (for better visualization of the upper-layer structures). The colour of the structure indicates the z position.

Movies 2~5 (example below): the evolution of

(i) vertical velocity w (on planes I, II, III and IV), spanwise velocity v (on plane V), and streamwise velocity u (vectors on the IV plane),

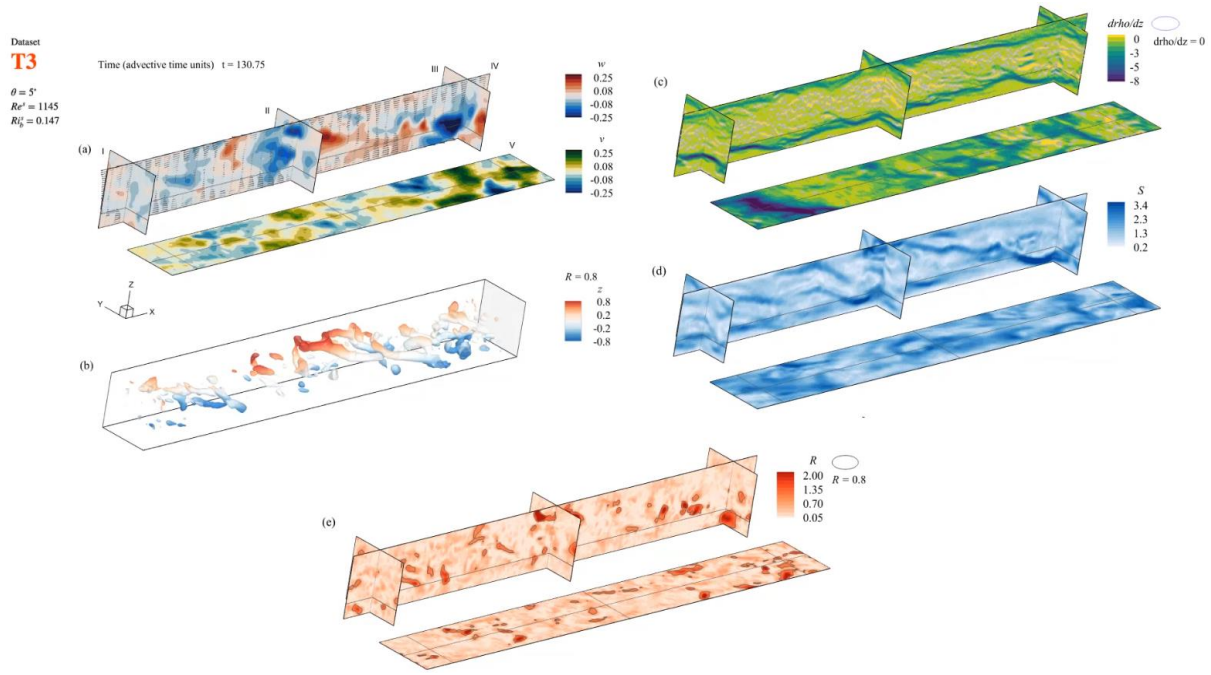
(ii) iso-surfaces of R,

(iii) iso-surfaces of S (only shown in movie 2),
(iv) contours of density gradient $\partial\rho/\partial z$,
(v) contours of S,
(vi) contours of R,

We split each regime into a separate movie:

movie 2: H regime (H1-H4)
movies 3-4: I regime (I1-I8)
movie 5: T regime (T1-T3)

The isosurfaces are smoothed to reduce noise. All panels show the same viewing angle. The x-z plane, x-y plane and all y-z planes in each panel are the same as those in panel *(a)*. The locations of the planes in the movies 2-5 are the same as the movies in [1]. However, we only show the "shear layers" here (excluding the near-wall data), as shown below.



2. Code

We provide the following Matlab code used to generate the above Rv and Sv data from [1]. The directory path must be changed and adapted to your machine.

RSdecomposition1.m This script was used for the R-S decomposition based on the three-dimensional velocity field provided in [1] using the algorithm described in [2]. A function **RSdecomp** is included in the script to calculate velocity gradient tensor and its eigenvalue/eigenvector at each point and time step. To improve numerical precision and computing efficiency, a higher-order difference scheme and high-efficiency algorithm may be desirable, but we did not feel the need for it.

References

[1] LEFAUVE, A. & LINDEN, P. F. 2022 Research data supporting "Experimental properties of continuously-forced, shear-driven, stratified turbulence" [Dataset]. doi.org/10.17863/CAM.75370

[2] XU W. & Y. Gao, et al. 2019 An explicit expression for the calculation of the rortex vector. Phys. Fluids 31 (9), 095102.