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Visualization of invariant sets in incompressible fluid flows from Lagrangian data MARKO BUDIŠIĆ, IGOR MEZIĆ, University of California - Santa Barbara — We analyze Lagrangian data of incompressible fluid flows to provide a coarse-grained visualization of material transport. It is often difficult to resolve features in 3D plots of trajectories. Instead, we visualize sets that are transport-invariant. In spirit, the algorithm groups trajectories that are similar *on average* into invariant sets of different spatial scales. Invariant sets are represented by level-sets of flow-invariant functions, which partition the space. We construct such invariant functions by averaging a basis set, e.g., Fourier basis, along Lagrangian trajectories. Our Ergodic Quotient algorithm then combines trajectory averages to form scale-ordered invariant partitions. The lower orders visualize coarse features, e.g., dominant vortices, while higher orders resolve sub-features, e.g., secondary vortices weaving around the dominant ones. The algorithm is suitable for visualization of both numerical and experimental Lagrangian data. It has a benefit of not requiring an access to the entire space: it is possible to resolve the features even by seeding initial conditions into experimentally accessible regions and allowing for the flow to disperse the tracers. We demonstrate the algorithm on several numerical flows and explain future extensions.

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