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Coherent structure coloring: identification of coherent structures from sparse flow trajectories using graph theory[1] KRISTY SCHLUETER, JOHN DABIRI, Stanford University — Coherent structure identification is important in many fluid dynamics applications, including transport phenomena in ocean flows and mixing and diffusion in turbulence. However, many of the techniques currently available for measuring such flows, including ocean drifter datasets and particle tracking velocimetry, only result in sparse velocity data. This is often insufficient for the use of current coherent structure detection algorithms based on analysis of the deformation gradient. Here, we present a frame-invariant method for detecting coherent structures from Lagrangian flow trajectories that can be sparse in number. The method, based on principles used in graph coloring algorithms, examines a measure of the kinematic dissimilarity of all pairs of flow trajectories, either measured experimentally, e.g. using particle tracking velocimetry; or numerically, by advecting fluid particles in the Eulerian velocity field. Coherence is assigned to groups of particles whose kinematics remain similar throughout the time interval for which trajectory data is available, regardless of their physical proximity to one another. Through the use of several analytical and experimental validation cases, this algorithm is shown to robustly detect coherent structures using significantly less flow data than is required by existing methods.

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