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Lagrangian Coherent Structures in Three-Dimensional Fluid Flows[1]

CLARENCE ROWLEY, Princeton University

We use Finite-Time Lyapunov Exponents (FTLE) to identify Lagrangian Coherent Structures in several three-dimensional flows, including a single isolated hairpin vortex, and a fully developed turbulent flow. These results are compared with commonly used Eulerian criteria for coherent vortices. Despite additional computational cost, the FTLE method has several advantages over Eulerian methods, including greater detail and the ability to define structure boundaries without relying on a preselected threshold. We also describe an application involving transport of charged particles in a toroidal magnetic field, which illustrates some limitations of the standard FTLE method when applied to a compressible medium. In collaboration with Melissa Green and Peter Norgaard, Princeton University.

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