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Detection of Lagrangian Coherent Structures in 3D Turbulence MELISSA GREEN, CLARENCE ROWLEY, Princeton University, GEORGE HALLER, Massachusetts Institute of Technology — Direct Lyapunov Exponents (DLE) are used to identify Lagrangian coherent structures in two different three-dimensional fluid 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. We find that the DLE method has several advantages over Eulerian methods, including greater detail and the ability to define structure boundaries without relying on a preselected threshold. As a further advantage, the DLE method requires no velocity derivatives, which are often too noisy to be useful in the study of a turbulent flow. We study the evolution of a single hairpin vortex into a packet of similar structures, and show that the birth of a secondary vortex corresponds to a loss of hyperbolicity of the Lagrangian coherent structures.

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