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Vortex boundaries as barriers to vorticity transport in two-dimensional flows[1] STERGIOS KATSANOULIS, ETH Zurich, MOHAMMAD FARAZMAND, Massachusetts Institute of Technology, MATTIA SERRA, Harvard University, GEORGE HALLER, ETH Zurich — Recent advances have revealed barriers to diffusive transport as material curves that inhibit the transport of diffusive scalars more than neighboring curves do. Extending these results, we discuss a new, fully frame-independent (objective) vortex identification method for two-dimensional flows. Our method locates vortex-core boundaries as closed material curves that inhibit the diffusion of vorticity more than other nearby material curves do. The exact solution to this calculus of variations problem provides a criterion that unites common features of empirical observations: the material and vorticity-transporting nature of observed vortex cores. We also discuss an algorithm, along with a publicly available numerical package, that enables the automatic extraction of maximally vorticity-preserving, material vortex cores from two-dimensional data sets. We conclude by demonstrating this algorithm on explicit Navier-Stokes solutions and two-dimensional turbulence simulations.

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