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Separating stretching from folding in fluid mixing DOUGLAS H. KELLEY, NICHOLAS T. OUELLETTE, Yale University — Efficient large-scale mixing depends on stretching and folding — together they expand the periphery of material volumes, allowing diffusion to mix at small scales. Yet stretching and folding are difficult to decouple in real flows with complex spatiotemporal structure. We distinguish the two processes mathematically and study them separately in a laboratory flow. Our experimental apparatus is a quasi-two-dimensional electromagnetically driven stratified solution with lateral dimensions 90 cm x 90 cm. Optically tracking $\sim$30 000 particles per frame with a high-speed camera, we reconstruct the velocity field and express fluid deformations as the unique sum of an affine component (primarily stretching) and a non-affine component (primarily folding). At short times stretching dominates, but once fluid elements have elongated, folding becomes suddenly stronger and dominates thereafter. The relative strength of the two processes also varies strongly in space. This work is supported by the National Science Foundation.

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