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Optimal advective mixing by two-dimensional chaotic Stokes flows DAVID SAINTILLAN, QIZHENG YAN, MechSE, University of Illinois at Urbana-Champaign — Numerous mixing strategies in microfluidic devices rely on chaotic advection by time-dependent body forces. The question of determining the required forcing function to achieve optimal mixing at a given kinetic energy or power input remains however open. Using finite-horizon optimal control theory, we numerically determine general optimal mixing flows in a two-dimensional periodic geometry as truncated sums of time-modulated Fourier modes. The time-averaged power spectra of these flows are calculated to investigate the effect of scale. We demonstrate that optimal mixing flows with fixed kinetic energy contain a wide range of spatial scales, whereas those with fixed power input are strongly dominated by large scales. We also determine the frequency spectra of the time-modulating functions and characterize the importance of non-harmonic forcing.

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