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A Mapping method for mixing with diffusion CONOR P. SCHLICK, IVAN C. CHRISTOV[1], PAUL B. UMBANHOWAR, JULIO M. OTTINO, RICHARD M. LUEPTOW, Northwestern University — We present an accurate and efficient computational method for solving the advection-diffusion equation in time-periodic chaotic flows. The method uses operator splitting which allows advection and diffusion steps to be treated independently. Taking advantage of flow periodicity, the advection step is solved with a mapping method, and diffusion is added discretely after each iteration of the advection map. This approach allows for a "composite" mapping matrix to be constructed for an entire period of a chaotic advection-diffusion process, which provides a natural approach to the spectral analysis of mixing. To test the approach, we consider the two-dimensional time-periodic sine flow. When compared to the exact solution for this simple velocity field, the operator splitting method exhibits qualitative agreement (overall concentration structure) for large time steps and is quantitatively accurate (average and maximum error) for small time steps. We extend the operator splitting approach to three-dimensional chaotic flows. Funded by NSF Grant CMMI-1000469.

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