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On the effect of finite-time correlations on the turbulent mixing in smooth chaotic compressible velocity fields[1] SIIM AINSAAR, Institute of Physics, University of Tartu, JAAN KALDA, Institute of Cybernetics, Tallinn University of Technology — For incompressible flows, most theoretical studies about turbulent mixing have used the Kraichnan model where the velocity field has zero correlation time. Most of their predictions are derived through (the ratios of) two sets of parameters: Lyapunov exponents (LEs), and their "diffusivities" (defined as the asymptotic values of $t\mathrm{Var}(\Lambda)$; Λ is a finite-time LE for time t). However, for compressible flows, there is a serious mismatch between the theoretical predictions for these parameters, and both simulations and experiments. We present a simple theoretical model that derives the LEs and their "diffusivities" from basic statistics of the velocity gradient tensor $\nabla\mathbf{v}$. For finite correlation times, there is a breakdown of universality: the ratios of these parameters do not depend only on the flow compressibility and the correlation time, but also on the determinant of $\nabla\mathbf{v}$ - a parameter discussed very sparsely, so far. Our model is in a good agreement with previously unexplained studies regarding the role of finite time correlations [G. Boffetta et al, 2004]. Our mapping from the statistics of $\nabla\mathbf{v}$ to the LEs and their "diffusivities" extends a wide range of existing analytical "Kraichnanian" results to real time-correlated flows.

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