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Scalar Mixing Enhancement via Streamwise Vortices and their Excited Wavy Instabilities in a Free Shear Flow J.T.C. LIU, Brown University — Scalar mixing enhancement for an incompressible inert fluid is considered in a spatially developing shear layer. For steady Görtler type streamwise vortices, similarity of streamwise momentum with scalar transport problems is possible for Prandtl and Schmidt numbers unity.[1] Momentum conservation equations for the nonlinear wavy instabilities, and those for unsteady scalar transport are examined in detail. The streamwise fluctuation pressure gradient prevents similarity as for steady flow; it is estimated in terms of the fluctuation dynamical pressure and found to be much weaker than advective transport. Similarity between fluctuation streamwise velocity, temperature and concentration now becomes possible for Prandtl and Schmidt numbers unity. Behavior of scalar fluctuations is then inferred from the fluctuation streanwise momentum.[2] The wavy-instability modified heat and mass transport owing to the most amplified nonlinear sinuous mode is assessed. It is found that the nonlinearity of the wavy instabilities enhance scalar mixedness over a significant developing streamwise region well above that achieved by the steady, unmodified streamwise vortices alone.
[1]J.T.C. Liu and A.S. Sabry, *Proc. Royal Soc. London*, Ser. A **432,** 1-12 (1991).
[2]I.G. Girgis and J.T.C. Liu, *J. Fluid Mech.* **468**, 29-75 (2002).

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