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Significant Surface Heat Transfer Rate Enhancement and Scalar Transport under Secondary Instabilities of Steady Longitudinal Vorticity Elements in Boundary Layers. J. T. C. LIU, Brown University — Nonlinear wavy secondary instability of steady longitudinal vortices in boundary layer flow, characterized by the sinuous mode, give rise to skin friction well above the local turbulent boundary layer values[1] because the Reynolds stress contributes to fluctuation momentum flux towards the wall[1]. Measurements of time-averaged surface heat transfer rates in air show a similar behavior[2]. Similarity between dimensionless total streamwise velocity and dimensionless temperature is valid for the steady problem[3] for Prandtl number unity, but is hampered here by the presence of fluctuation streamwise-pressure gradient which has no counterpart in the scalar transport equation. Estimates for not-so-long waves relative to the local conductivity scale length show that the fluctuation streamwise pressure gradient is small, thus making similarity approximately possible. We conclude that the normal-to-wall fluctuation heat flux contributes to transport towards the wall, squashing the iso-temperature lines and increasing the temperature gradient thus make plausible a mechanism for the overshoot of surface heat transfer rate. [1] J.T.C. Liu and I.G Girgis, Abstract in ICTAM'04 Proceedings, Warsaw (2004). [2] L. Momayez, P. Dupont and H. Peerhossaini, Int. J. Heat Mass Transfer **47**, 3783 (2004). [3]J.T.C. Liu and A.S. Sabry, Proc. Royal Soc. **A432**, 1 (1991).

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