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Turbulence scales and free-shear-flow noise RANDALL KLEINMAN, JONATHAN FREUND, University of Illinois at Urbana-Champaign — The role of turbulence scales in the generation of far-field sound is studied by direct numerical simulation of temporally-developing mixing layers. The range of scales is adjusted by varying the layer thickness Reynolds numbers by a factor of twelve in the different cases simulated. Turbulence kinetic energy and pressure spectra in the near field show the expected Reynolds number dependence, but far-field pressure spectra all decay rapidly with wavenumber and show less sensitivity to Reynolds number. Far-field streamwise wavenumber pressure spectra scale well with the layer momentum thickness, consistent with the insensitivity to Reynolds number of the largest turbulence structures. At higher wavenumbers the streamwise spectra scale best with the Taylor microscale. Above a momentum thickness Reynolds number of around 300, all the mixing layers radiate over 85 percent of the acoustic energy of the apparently asymptotically high-Reynolds-number value we are able to compute. Low wavenumbers account for nearly all of the acoustic energy in the far field. Implications of these results for large-eddy simulation of jet noise are discussed.

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