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Adjoint-based analysis of turbulent free shear flow noise RANDALL KLEINMAN, JONATHAN FREUND, University of Illinois at Urbana-Champaign — An adjoint-based control methodology has been developed that circumvents the complexities of the noise generation mechanisms in a free shear flow and allows for direct study of noise control. The numerical solution of the adjoint of the linearized and perturbed compressible flow equations provides the gradient information needed to improve controls in a conjugate-gradient optimization procedure. For generic forcing, the method has been implemented within a direct numerical simulation (DNS) framework and demonstrated successfully on a two-dimensional mixing layer. Currently, a three-dimensional turbulent mixing layer has been simulated and controlled via the adjoint method. The inflow of this calculation comes from an auxillary simulation of a streamwise-periodic mixing layer. Preliminary results show a corresponding 28% reduction, with simulations continuing. A sensitivity analysis has also been carried out using the adjoint system to assess the turbulence length scales affected by the control, as well as to study their contributions to different components of the sound field.

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