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Analysis of the near-field of an adjoint-based noise controlled Mach 1.3 turbulent jet JEONGLAE KIM, DANIEL BODONY, JONATHAN FREUND, University of Illinois at Urbana-Champaign — A noise-reduced Mach 1.3 turbulent jet is investigated to identify its sound-generating mechanisms. The adjoint of the perturbed and linearized Navier–Stokes equations is used in an inverse fashion to provide the control sensitivity to directly reduce sound radiation. The accuracy of this gradient in control parameter space is assessed by examining the variation of the cost functional for small-amplitude controls. The control found by the optimization algorithm reduces noise mainly via suppressing intermittent, large-amplitude acoustic radiation at lower angles and at jet preferred mode frequencies. This observation is similar to the adjoint-based optimization of sound radiated by two-dimensional non-turbulent mixing layers and suggests the subtle modification of large-scale vortical motions for noise reduction. The proper orthogonal decomposition is applied to the near-field pressure fluctuations and the changes in the optimal, orthogonal basis due to the control are analyzed. When controlled, the downstream evolution of large-scale structures shows less abrupt changes, which may be associated with the suppression of the intermittent acoustic radiation. The noise-reducing control is broadbanded in both space and time and demonstrates the characteristics of modulated instability wave packets. Optimizations are ongoing.

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