

An Empirical 'lower bound' on Free-Shear-Flow Noise

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The adjoint of the linearized compressible flow equations is formulated in such a way that it can be used to optimize local control actuation to reduce the noise radiated by a free shear flow. Both the flow and the adjoint are solved numerically and without modeling approximations. Jet noise is the technological application of interest, and a two-dimensional mixing layer is studied as a model of the near-nozzle region of a jet. It is found that the correct small perturbations near the inflow can dramatically reduce the radiated noise. This approach allows us to establish an empirical lower bound on the noise radiation by a this flow subject to our constraints. More importantly, it gives us an opportunity to study its mechanisms by providing noisy and quieted versions of the same flow. Superficially, the unsteady flow dynamics are remarkably unchanged despite a 10dB reduction in the noise.

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