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Input-output analysis of high-speed turbulent jet noise JINAH JEUN, JOSEPH W. NICHOLS, University of Minnesota — We apply input-output analysis to predict and understand the aeroacoustics of high-speed isothermal turbulent jets. We consider axisymmetric linear perturbations about Reynolds-averaged Navier-Stokes solutions of ideally expanded turbulent jets with Mach numbers $0.6 < M_j < 1.8$. For each base flow, we compute the optimal harmonic forcing function and its linear response by singular value decomposition of the resolvent operator. In addition to the optimal mode, input-output analysis also yields suboptimal modes associated with a spectrum of lesser singular values. For supersonic jets, the optimal response closely resembles a wavepacket in both the nearfield and the farfield such as those obtained by the parabolized stability equations (PSE), and this mode dominates the response. For subsonic jets, however, the singular values indicate that the contributions of suboptimal modes to noise generation are nearly equal to that of the optimal mode, explaining why PSE misses some of the farfield sound in this case. Finally, high-fidelity large eddy simulation (LES) is used to assess the prevalence of suboptimal modes in the unsteady data. By projecting LES data onto the corresponding input modes, the weighted gain of each mode is examined.

Jinah Jeun
University of Minnesota

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