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Global-mode based linear feedback control of a supersonic jet for noise reduction[1] MAHESH NATARAJAN[2], JONATHAN FREUND[3], DANIEL BODONY[4], University of Illinois at Urbana-Champaign — The loudest source of high-speed jet noise appears to be describable by unsteady wavepackets that resemble instabilities. We seek to reduce their acoustic impact with a control strategy that uses global modes to model their dynamics and structural sensitivity of the linearized compressible Navier-Stokes operator to identify an effective linear feedback control. For a case with co-located actuators and sensors adjacent the nozzle, we demonstrate the method on an axisymmetric Mach 1.5 jet. Direct numerical simulations using this control show significant noise reduction. Eigenanalysis of the controlled mean flows reveal fundamental changes in the spectrum at frequencies lower than that used by the control, with the quieter flows having unstable eigenvalues that correspond to eigenfunctions without significant support in the acoustic field. A specific trend is observed in the mean flow quantities as the flow becomes quieter, with changes in the mean flow becoming significant only further downstream of the nozzle exit. The quieter flows also have a stable shock-cell structure that extends further downstream. A phase plot of the POD coefficients for the flows show that the quieter flows are more regular in time.

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