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**Sensitivity analysis for the control of supersonic impinging jet noise**[1] JOSEPH W. NICHOLS, NATHANIEL HILDEBRAND, Aerospace Engineering and Mechanics, University of Minnesota — The dynamics of a supersonic jet that impinges perpendicularly on a flat plate depend on complex interactions between fluid turbulence, shock waves, and acoustics. Strongly organized oscillations emerge, however, and they induce loud, often damaging, tones. We investigate this phenomenon using unstructured, high-fidelity Large Eddy Simulation (LES) and global stability analysis. Our flow configurations precisely match laboratory experiments with nozzle-to-wall distances of 4 and 4.5 jet diameters. We use multi-block shift-and-invert Arnoldi iteration to extract both direct and adjoint global modes that extend upstream into the nozzle. The frequency of the most unstable global mode agrees well with that of the emergent oscillations in the LES. We compute the "wavemaker" associated with this mode by multiplying it by its corresponding adjoint mode. The wavemaker shows that this instability is most sensitive to changes in the base flow slightly downstream of the nozzle exit. By modifying the base flow in this region, we then demonstrate that the flow can indeed be stabilized. This explains the success of microjets as an effective noise control measure when they are positioned around the nozzle lip.

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