Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Global Modes of High Speed Jet Noise[1] JOSEPH W. NICHOLS, SANJIVA K. LELE, PARVIZ MOIN, Center for Turbulence Research, Stanford University, Stanford, CA 94305 — We consider instability wave mechanisms for sound generation in supersonic jets from the perspective of global mode analysis. Using a shift-and-invert Arnoldi method, global modes are extracted from direct numerical simulations of perturbations governed by the fully compressible linearized Navier–Stokes equations. As fully 3D eigenfunctions of the linear stability problem, global modes capture directly effects of base flow non-parallelism. For example, we find a significant sound producing region just downstream of the supersonic core of a transonic jet. In addition, maximum transient growth is computed from an optimal superposition of non-normal global modes. While purely linear, we suggest that this transient growth, composed of several frequencies, may be key to predicting eventual nonlinear mode interactions responsible for low frequency sound production. Finally, sensitivities of the global eigenvalues to base flow modifications are calculated from an overlap of direct and adjoint global modes, suggesting strategies for passive control of jet noise.

[1]This research is supported by NASA contract no. NNX07AC94A.

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Date submitted: 10 Aug 2009 Electronic form version 1.4