Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Study of supersonic components in high-speed turbulent jets using wavenumber-frequency domain filtering and POD[1] JAIYOUNG RYU, SANJIVA LELE, Stanford University — Near-field characteristics of supersonic components are investigated using LES database by Bodony and Lele (2005). Three unheated jets with jet Mach number ranging from 0.51 to 1.95, and one heated transonic jet are considered. Supersonic components are decomposed from full flow field using wavenumber-frequency domain filtering. Spatial structure of the fluctuating pressure field is obtained by computing proper orthogonal components (POD modes) of the full and filtered data. POD modes of subsonic jet ($M_j = 0.51$) reveals large scale-disparity between full and supersonic components. For the supersonic jet at $M_j = 1.95$, the energetic structures of the pressure field also contribute significantly to the supersonic components and scale disparity is absent. The subsonic pressure variance can be rescaled by V_j^4 (i. e. $||P^2|| \sim V_j^4$), which is an expected scaling for turbulence associated pressure fluctuations, whereas supersonic pressure variance can be rescaled with V_j^8, which is consistent with the far-field noise intensity scaling associated with Lighthill's analogy. Filtered velocity components are also rescaled and similar pattern is observed (i. e. supersonic near-field veolocity scales as far-field disturbances).

[1]This research has been supported by the Boeing Company.

Jaiyoung Ryu
Stanford University

Date submitted: 11 Aug 2010 Electronic form version 1.4