Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Dynamics of the Coherent Structures in a Supersonic Rectangular Jet of Aspect Ratio 2 KAMAL VISWANATH, ANDREW CORRIGAN, RYAN JOHNSON, KAZHIKATHRA KAILASANATH, Naval Research Lab, EPHRAIM GUTMARK, University of Cincinnati, UNIVERSITY OF CINCINNATI TEAM, LABORATORIES FOR COMPUTATIONAL PHYSICS AND FLUID DYNAMICS TEAM — Asymmetric exhaust nozzle configurations, in particular rectangular, are likely to become more important in the future for both civilian and military aircraft. Various nozzle geometry features including the presence of sharp corners impact the evolution of the cross-sectional shape of the jet and its mixing features. Asymmetric nozzles potentially offer a passive way of affecting mixing for low aspect ratio jets through both large-scale entrainment due to coherent structures and fine scale mixing at the corners. Data is presented that show the dynamic evolution of the coherent structures for an ideally expanded rectangular nozzle of aspect ratio 2. The sense of the vortex pairs setup through the self-induction at the corners and stretching of the azimuthal vortex ring into streamwise vortices results in diagonal elongation of the time-averaged jet cross-section and contraction at the sides. The phase averaged velocity contours further clearly show the effect of mixing at the sharp corners and the deformation of the rectangular exit cross-section as it propagates downstream. It is observed that the dominant vortex pairs in this case work against axis-switching.

Kamal Viswanath
Naval Research Lab

Date submitted: 01 Aug 2016 Electronic form version 1.4