Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Unstructured Large Eddy Simulations of Hot Supersonic Jets from a Chevron Nozzle[1] GUILLAUME BRÈS, Cascade Technologies Inc., JOSEPH NICHOLS, SANJIVA LELE, Stanford University, FRANK HAM, Cascade Technologies Inc. — Large eddy simulations (LES) are performed for heated supersonic turbulent jets issued from a converging-diverging round nozzle with chevrons. The unsteady flow processes and shock/turbulence interactions are investigated with the unstructured compressible flow solver "Charles" developed at Cascade Technologies. In this study, the complex geometry of the nozzle and chevrons (12 counts, 6° penetration) are explicitly included in the computational domain using unstructured body-fitted mesh and adaptive grid refinement. Sound radiation from the jet is computed using an efficient frequency-domain implementation of the Ffowcs Williams–Hawkings equation. Noise predictions are compared to experimental measurements carried out at the United Technologies Research Center for the same nozzle and operating conditions. The initial blind comparisons show good agreement in terms of spectra shape and levels for both the near-field and far-field noise. The current results show that the simulations accurately capture the main flow and noise features, including the shock cells, broadband shock-associated noise and turbulent mixing noise. Additional analysis of the large database generated by the LES is ongoing, to further investigate jet noise sources and chevron effects.

[1]This work is supported by NAVAIR grant N68335-11-C-0026 managed by Dr. John Spyropoulos. The simulations were carried out at DoD supercomputer facilities in ERDC and AFRL as part of the HPC Challenge Project NAWCP30952C5.

Guillaume Brès
Cascade Technologies Inc.

Date submitted: 02 Aug 2012 Electronic form version 1.4