Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Modelling peak supersonic heated jet noise at fixed jet or fixed acoustic Mach number using an acoustic analogy-based non-parallel flow asymptotic approach MOHAMMED AFSAR, University of Strathclyde, ADRIAN SESCU, Mississippi State University, EDMONDO MINISCI, University of Strathclyde — This presentation provides a summary of our recent results on supersonic jet noise prediction using the generalized acoustic analogy approach. The analogy poses a formula for the far-field sound as a convolution product of propagator tensor and the fluctuating Reynolds stress auto-covariance tensor. We found that approximating the propagator tensor using a non-parallel flow asymptotic approximation (Afsar et al., 2019. Phil. Trans. A, in press) of the vector Green's function that satisfies the adjoint linearized Euler equations allows accurate prediction of the peak jet noise. That is, in the small observation angle region, the predictions remain within 1-2 dB of experimental data up to a Strouhal number (based on jet diameter) of at least 0.5. We based the analogy on a model of the Reynolds stress auto-covariance that agrees with Large-Eddy Simulations in isothermal conditions. In general, our predictions recover both the spectral quietening observed in heated jets at fixed acoustic Mach number (Afsar et al. AIAA J., vol.49, p.2522, 2011) and the noise enhancement at fixed jet Mach number. We observed that in either of these cases, using the simpler non-spreading locally parallel flow based Greens function results in a significant under prediction of sound.

Mohammed Afsar
University of Strathclyde

Date submitted: 30 Jul 2019 Electronic form version 1.4