Ph.D. Thesis Defense

by

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"Comparison Between Beamforming and Nearfield Contours for Source Location in Subsonic and Supersonic Jets of Various Geometries"

Abstract:

Over the years, the need to understand and reduce aircraft noise emissions has led numerous researchers to apply various source location techniques to jet noise. Prior to 1985, several methods for determining jet-noise source locations were explored: acoustic mirrors, microphone arrays, two-microphone methods, causality correlation and coherence techniques, nearfield contour surveys, and automated source breakdown. More recently there have been developments in the microphone array, notably acoustic beamforming, and two-microphone method techniques. Many of the older techniques require significant amount of time to acquire data at each jet condition; this requirement is often caused by the necessity to move microphones in order to obtain source locations at all frequencies. The acoustic beamformer does not need to be moved during the acquisition of data, resulting in very rapid tests compared to other source-location methods.

Upon examination of prior studies containing jet noise source location measurements, it is clear that there are a few areas in the field that need additional work: (1) no study has compared the results of the acoustic beamforming method with another method using the same nozzles and facilities, (2) no study has been performed that analyzes the effects of differing nozzle geometry, and hence the nozzle exit boundary layer, on the jet noise source location, (3) no study has performed a detailed analysis of the noise source distributions of supersonic jets, and (4) no study has examined the noise source distribution of twin jets and the effect of separation distance on the said distribution. The goal of this current work is to systematically address these areas with the use of source location measurements, schlieren flow visualization, farfield spectra, and jet velocity measurements. The source location measurements are primarily acquired using an acoustic beamformer. Jet velocity measurements include both nozzle exit boundary layer profiles and downstream velocity profiles and are obtained with the use of boundary layer probes and particle imaging velocimetry.

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