

Viability of modern supersonic air transport is dictated by the aeroacoustic properties of the nozzles generating thrust. Aeroacoustic properties of a supersonic diamond nozzle, with enhanced analysis provided through comparisons to rectangular and elliptic nozzle geometries will be discussed in the present study.

The focus is on understanding how these non-axisymmetric jets influence noise generation across a range of nozzle pressure ratios (NPRs) in overexpanded, ideally expanded, and underexpanded flow regimes. Experimental techniques, including acoustic measurements and quantitative flow visualization, were employed to capture detailed data on velocity fields, shock-cell structures, acoustic emissions, and fully reconstruct their inherently three-dimensional forms.

The diamond nozzle generally demonstrated favorable acoustic performance compared to the rectangular and elliptic jets. Unique noise characteristics were observed, especially in relation to axis-switching phenomena, which were more prevalent in the rectangular and elliptic nozzles. These phenomena played a significant role in dictating noise emission patterns and overall acoustic behavior.

Additionally, the study explored the effect of heating on jet noise, with heated jets exhibiting enhanced mixing and reductions in noise, particularly in the overexpanded flow regime. The insights gained from this research contribute to a more comprehensive understanding of the relationship between nozzle geometry, flow dynamics, and acoustic emissions, offering valuable considerations for the design of quieter supersonic jets in both military and commercial aviation contexts.