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Investigation of the Near-Field Acoustic and Flow Properties of Imperfectly Expanded Supersonic Jets using Particle Image Velocimetry[1]
EPHRAIM GUTMARK, DAVID MUNDAY, University of Cincinnati, JUNHUI LIU, K. KAILASANATH, Naval Research Laboratory — The flow fields of imperfectly Expanded Supersonic Jets from conical CD nozzles are investigated by Particle Image Velocimetry. This nozzle geometry represents the exhaust nozzles on high-performance military engines. The results are compared with shadowgraph to bring out the details of the highly accelerated regions where seed particles may lag behind the flow, viz. the shocks and Prandtl-Meyer fans. Nozzles with three area ratios are examined over a wide range of under- and over-expanded conditions as well as the design conditions for each nozzle. It is found that this type of nozzle is not shock free at the design condition due to the sharp change of the geometry in the throat area. Both near-field and far-field acoustic measurements are presented. Flow-field and near-field acoustic measurements are compared with Numerical simulations in the accompanying presentation by Liu, Kailasanath and Ramamurti. The distributions of the centerline static pressure and noise spectra are in good agreement with the corresponding experimental data.

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David Munday
University of Cincinnati

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