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Noise source detection and measurement in a supersonic air jet using Ultra-high Speed Rainbow Schlieren Deflectometry[1] MANIK RAJORA, University of Louisiana at Lafayette, AJAY AGRAWAL, WILLIAM MITCHELL, PANKAJ KOLHE, University of Alabama — Supersonic jets emit noise from various regions including the shear layer containing vortical structures, various shock cell structures in the near field and the downstream jet core breakdown region. Sound waves emitted from these various regions interact with each other and produce distinct noise spectra away from the jet, which depends upon the measurement location. Typically sound is detected by intrusive probes that provide measurements at a specific location, which makes it difficult to identify the origination point of such noise in a supersonic jet. In this study, an ultra-high speed Rainbow Schlieren Deflectometry (RSD) technique has been developed to optically visualize not only the supersonic jet flow but also the sound waves emanating from it in real time. Color schlieren images are acquired at up to 250,000 frames per second to capture the sound wave propagation with adequate spatial resolution. Optical components of the system were optimized to improve the spatial and temporal resolutions and hence, the schlieren video quality. To the best of our knowledge, this is the first time sound wave propagation from supersonic jets has been recorded in real time on a schlieren video. Acquired color schlieren images are amenable to quantitative analysis, and can provide data on sound power and sound wave frequency across the whole field.

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