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Extraction of Large-Scale Coherent Structures Associated with Broadband Shock-Associated Noise in Supersonic Jets WEIQI SHEN, TRUSHANT PATEL, STEVEN MILLER, University of Florida — Broadband shock-associated noise (BBSAN) is analyzed with a large-eddy simulation (LES) of two off-design supersonic jets. The simulation results are validated with experiments. An acoustic analogy based on the decomposition of the Navier-Stokes equations is used to isolate the source of BBSAN. The BBSAN source term is the scalar product of anisotropic velocities and mean pressure gradients. The source term was validated in a previous work using a statistical method. A deterministic approach is adopted in the present work, which uses an LES database to obtain the BBSAN spectra. Proper orthogonal decomposition (POD) is applied to the scalar source field to extract the large-scale coherent structures associated with BBSAN. The eigenvalue spectra show low-rank behavior at the dominant BBSAN frequencies. Directivity plots of the BBSAN intensity are generated from different POD modes at the peak frequency. The leading modes of the source term show strong amplification in the observer direction. The key features of the BBSAN spectra are preserved when only a small fraction of POD modes is used. Noise source contour plots calculated with these POD modes reveal that most noise sources are distributed at the shock turbulence interactions and within the potential core.

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