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Mode Decomposition of a Supersonic Jet Using Momentum Potential Theory UNNIKRISHNAN SASIDHARAN NAIR, DATTA GAITONDE, The Ohio State University — We adopt Doaks momentum potential theory to investigate the acoustic, thermal and hydrodynamic modes in a Mach 1.3 cold jet. A statistically stationary LES of the jet is subjected to Helmholtz decomposition to yield the solenoidal and irrotational components of the momentum density. The irrotational component is further decomposed into acoustic and thermal modes. The data confirms the quantitative radial decay rates of the hydrodynamic and acoustic fields as well as the experimentally observed universal spectrum specific to the downstream and sideline directions. The irrotational field in the core exhibits an axially coherent jittering wave-packet with an internal frequency of St 0.4, yielding the highly directional downstream radiation at St 0.2. The intrusion of rolled up vortices from the expanding shear layer into the core induces a coherent perturbation zone in the irrotational component, which persists and propagates into the nearfield resulting in intermittent noise events. The interaction of the fluctuating solenoidal field with the fluctuating Lamb vector in the core of the jet is found to be the most prominent source, while its interaction with the fluctuating entropy gradient is found to be a sink in this cold jet.

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