Abstract Submitted
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Aeroacoustic Noise Predictions using Nonlinear PSE Based Methods[1] LAWRENCE CHEUNG, SANJIVA LELE, Stanford University — High-fidelity simulations of aeroacoustic radiation from free shear flows typically involve computationally expensive DNS or LES computations to resolve the dynamically important temporal and spatial scales. We present a hybrid method to predict the far-field sound of shear layers, using a combination of the Nonlinear Parabolized Stability Equations (NPSE) and an appropriate acoustic analogy. The NPSE provide an efficient and accurate way to capture the large-scale hydrodynamics of the flow, and are used to calculate the source terms for an acoustic analogy method to predict the far-field sound. Four cases are considered in this study: an isothermal supersonic, a heated supersonic, an isothermal subsonic, and a heated supersonic shear layer. Comparisons between the NPSE simulations and their DNS counterparts are shown. In both of the supersonic shear layers, we find that the NPSE solution is accurate in both the near field and far field regions. For the subsonic shear layers, the NPSE only captures the near field hydrodynamics and underpredicts the acoustic radiation. However, when combined with Lilley's acoustic analogy, reasonable agreement is found with DNS calculations. Comparisons with other acoustic analogies, such as Lighthill's method, will also be shown.

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