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**Interaction of a turbulent boundary layer with a cavity-backed circular orifice and tonal acoustic excitation**[1] QI ZHANG, DANIEL BODONY, University of Illinois at Urbana-Champaign — Acoustic liners are effective reducers of jet exhaust and core noise and work by converting acoustic-bound energy into non-radiating, vorticity-bound energy through scattering, viscous, and non-linear processes. Modern liners are designed using highly-calibrated semi-empirical models that will not be effective for expected parameter spaces on future aircraft. The primary model limitation occurs when a turbulent boundary layer (TBL) grazes the liner; there are no physics-based methods for predicting the sound-liner interaction. We thus utilize direct numerical simulations to study the interaction of a Mach 0.5 zero pressure gradient TBL with a cavity-backed circular orifice under acoustic excitation. Acoustic field frequencies span the energy-containing range within the TBL and amplitudes range from 6 to 40 dB above the turbulent fluctuations. Impedance predictions are in agreement with NASA Langley-measured data and the simulation databases are analyzed in detail. A physics-based reduced-order model is proposed that connects the turbulence-vorticity-acoustic interaction and its accuracy and limitations are discussed.

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