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LES Investigation of Core Noise Mechanisms inside a Combustor-Nozzle System JEFFREY O'BRIEN, Stanford University - Center for Turbulence Research, FRIEDRICH BAKE, German Aerospace Center (DLR) - Institute of Propulsion Technology, JEONGLAE KIM, MATTHIAS IHME, Stanford University - Center for Turbulence Research — The aim of the work is to expand knowledge of core noise physics through the study of a representative aviation-type combustor with converging-diverging nozzle attached to the exhaust. First, a fully compressible LES of the entire flowpath is performed and validated against experimental measurements. From this calculation, the time history of the flow is sampled in a plane near the nozzle entrance to construct a library of representative fluctuations that are potential precursors to the direct indirect noise observed at the nozzle outlet. This data is then used as an inflow for a series of separate nozzle simulations in which fluctuations in pressure, temperature ("hot spots"), and mixture composition are imposed separately to isolate their effect on the emitted noise. This methodology allows quantitative investigation of core-noise physics that lower-order models do not, including: the effect of non-linearity of high-amplitude perturbations, superposition of forcing types, the impact of the spatial structure of the perturbations, and the restriction to low-frequency perturbations and calorically perfect gas assumption. The calculations also represent the first time variations in mixture composition have been shown to induce downstream noise in a high-fidelity, 3D simulation.

Jeffrey O'Brien
Stanford University - Center for Turbulence Research

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