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Direct numerical simulation and reduced-order modeling of the sound-induced flow through a cavity-backed circular under a turbulent boundary layer QI ZHANG, DANIEL BODONY, University of Illinois at Urbana-Champaign — Commercial jet aircraft generate undesirable noise from several sources, with the engines being the most dominant sources at take-off and major contributors at all other stages of flight. Acoustic liners, which are perforated sheets of metal or composite mounted within the engine, have been an effective means of reducing internal engine noise from the fan, compressor, combustor, and turbine but their performance suffers when subjected to a turbulent grazing flow or to high-amplitude incident sound due to poorly understood interactions between the liner orifices and the exterior flow. Through the use of direct numerical simulations, the flow-orifice interaction is examined numerically, quantified, and modeled over a range of conditions that includes current and envisioned uses of acoustic liners and with detail that exceeds experimental capabilities. A new time-domain model of acoustic liners is developed that extends currently-available reduced-order models to more complex flow conditions but is still efficient for use at the design stage.

Qi Zhang
University of Illinois at Urbana-Champaign

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