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Direct Numerical Simulation of Grazing Flow over an Acoustic Liner in a Sound Field CHRISTOPHER TAM, HONGBIN JU, Department of Mathematics, Florida State University — The effect of grazing flow on the fluid mechanical and acoustic performance of an acoustic liner in a sound field is investigated by direct numerical simulation. The simulations are carried out using the Dispersion-Relation-Preserving (DRP) scheme and advanced computational aeroacoustic (CAA) boundary conditions. The computation algorithm is verified by comparing numerical results with an exact linear solution. At high incident sound pressure level, the flow at the mouths of the resonators of the liner is dominated by vortex shedding. Vortex shedding, which converts acoustic energy into rotational kinetic energy of the shed vortices that are subsequently dissipated by viscosity, is the dominant mechanism for damping incident acoustic waves. The grazing flow organizes the shed vortices into a single large vortex. This large vortex is convected downstream by the mean flow. This convected vortex has the potential of disrupting the flow of the downstream resonator. Past models of acoustic liners do not include this fluid mechanical interaction between resonators. Modification, therefore, becomes necessary. At low level of incident sound waves, the flows at the mouths of the resonators of the liner consist mainly of oscillatory shear layers. Viscous dissipation is the main damping mechanism. Computed streamline patterns of the flow are found to exhibit remarkable resemblance to those measured experimentally.

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