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Oscillations of Shear Flow Past a Perforated Plate Bounded by a Cavity: Physical Mechanisms and Attenuation EMINE CELIK, DONALD ROCKWELL, Lehigh University — Grazing flow of a turbulent boundary layer along a perforated plate, bounded by a closed cavity on its backside, can give rise to a long wavelength, self-excited instability. A cinema technique of high-image-density particle image velocimetry, which provides a space-time representation of the unsteadiness over an entire plane, is employed to characterize the coupling between distinctively different patterns of the flow structure along the back (low-speed) and front (high-speed) sides of the plate. Global cross-spectral analysis, attainable via the space-time imaging technique, leads to patterns of amplitude and phase of the predominant spectral component, along and across the plate. This approach, together with complementary types of image evaluation, delineates the physics of the oscillation, which includes: (i) downstream propagating disturbances along either side of the plate; and (ii) a coherent region of unsteadiness at its trailing-edge. Attenuation of the oscillation can be achieved by insertion of a ramp at the leading-edge, which generates a defect layer along the surface of the plate.

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