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Poroelastic Trailing Edge Noise and the Silent Flight of the Owl
JUSTIN JAWORSKI, NIGEL PEAKE, University of Cambridge — Many species of owl rely on specialised plummage to reduce their self-noise levels and enable hunting in acoustic stealth. One such plummage arrangement, a compliant array of feathers at the wing trailing edge, is believed to mitigate the scattering of boundary layer turbulence which is the predominant source of airframe noise. The owl noise problem is modelled analytically by the diffraction of a quadrupole source by a semi-infinite porous and elastic edge, and the resulting set of equations is solved exactly using the Wiener-Hopf technique to identify important dimensionless parameters and their scaling behaviour with respect to the aerodynamic noise produced. Special attention is paid to the limiting cases of elastic-impermeable as well as rigid-porous plate conditions, the latter of which is compared against available experimental measurements in the literature. Results from this analysis and comparison seek to validate the weaker sixth-power dependence of far-field acoustic power on flow velocity for porous trailing edges, develop a rigorous basis for the aeroacoustic tailoring of poroelastic edges to reduce airframe noise, and help explain one of the mechanisms of aerodynamic noise suppression by owls.

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