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On the sound generated by boundary-layer vorticity

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Turbulent boundary layers generate broadband noise as the effect of vortical-disturbances scattering into acoustic waves. The paper presents a formulation for evaluating of acoustic pressure in the field in terms of the transpiration velocity, here defined in terms of vorticity and closely related to Lighthill equivalent source. Specifically, the formulation used allows one to obtain, in the frequency domain, a matrix relationship between the transpiration velocity at a number of points on the body surface (those arising from boundary-element discretization) and the pressure at given points in the irrotational region. From this, the relationship between the corresponding PDF is easily obtained using the Wiener-Khintchine theorem.

The paper will include the general formulation, validating numerical results, and comparison with experimental data. The inverse problem, that is, determining the source intensity on the body surface from field noise (in particular, the invertibility of the operator), will be also addressed.