Abstract Submitted
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Computational study of roughness-noise mechanisms[1] QIN YANG, MENG WANG, University of Notre Dame — Boundary-layer flows over rough surfaces are known to be much noisier than smooth-wall boundary layers. To understand the source mechanisms for roughness noise, large-eddy simulations are performed for turbulent boundary-layer flows over a single hemispherical roughness element and a pair of roughness elements. The noise calculation based on Lighthill's theory highlights the role of unsteady drag dipoles, particularly the spanwise component, as the primary noise source. Noise-generation mechanisms are investigated through an analysis of the correlation and coherence between the dipole source functions and hydrodynamic pressure fluctuations on the surrounding surface, and through a numerical experiment with stress-free boundary conditions on the hemispheric surface, which eliminates shear-layer separation and vortex shedding and the associated noise. The results suggest that diffraction and distortion of incoming turbulence from upstream have an important effect on streamwise dipole radiation, while spanwise dipole radiation is more closely associated with turbulence structures generated by the hemisphere. The interaction of a hemisphere with the wake of an upstream hemisphere is shown to significantly enhanced noise radiation, particularly in the streamwise direction and at high frequencies.

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