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Computation and analysis of rotor-noise generation in grid turbulence[1] JUNYE WANG, KAN WANG, MENG WANG, University of Notre Dame — The noise of a ten-bladed rotor interacting with a grid-generated turbulent flow at low Mach number is computed using large-eddy simulation and the Ffowcs Williams-Hawkings extension to Lighthill's theory. The grid turbulence is approximated as convected homogeneous and isotropic turbulence generated by a separate simulation and provided as inflow boundary conditions. The sound pressure spectrum predicted by the simulation exhibits overall agreement with previous experimental measurements in terms of the spectral shape and level. The turbulence ingestion noise is broadband with small peaks at the blade passing frequency and its harmonics. It is significantly stronger than the rotor self-noise generated by blade trailing-edge vortex shedding. Consistent with experimental observations, decreasing the rotor advance ratio at fixed mean inflow velocity leads to an increase in the sound pressure level. Different levels of acoustic compactness assumptions are examined, and the results indicate that the blade chord is acoustically compact over the frequency range of interest. Blade to blade correlations of the acoustic dipole sources are shown to be small.

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