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Acoustic source mechanisms for boundary-layer flow over small steps[1] MENG WANG, MINSUK JI, University of Notre Dame — The aeroacoustics of low-Mach-number boundary-layer flow over small backward and forward facing steps is studied using large-eddy simulation and Lighthill's theory with a low frequency (compact step height) Green's function. The Reynolds number based on the step height and free-stream velocity ranges from 328 to 21000 as the step height varies from 0.83% to 53% of the boundary layer thickness. The steps act primarily as acoustic dipole sources aligned in the streamwise direction. Consistent with previous experimental measurements, the forward step is louder than the backward step, because it generates stronger sources in regions closer to the step corner, which is heavily weighted by the Green's function. A detailed analysis of flow field and Green's function weighted sources reveals that the backward step generates sound mainly through diffraction of the boundary-layer source field which is not much affected by the step in the acoustically important region, whereas the forward step generates sound through a combination of diffraction and turbulence modification by the step. As the step height decreases, the difference in sound level between forward and backward steps is much reduced as turbulence modification becomes less significant.

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Meng Wang
University of Notre Dame

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