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Wavenumber-frequency spectra of wall-pressure fluctuations in compressible turbulent channel flow[1] YI LIU, KAN WANG, MENG WANG, University of Notre Dame — Knowledge of wall pressure fluctuations in wall-bounded flows is important for predictions of structural vibration and noise. In this study, direct numerical simulations with a high-order, non-dissipative finite difference scheme are employed to accurately capture the spatiotemporal characteristics of wall pressure fluctuations in compressible turbulent channel flows at Mach 0.4 and friction Reynolds number of 180. Acoustic peaks are barely visible in the one-dimensional streamwise wavenumber-frequency spectra. However, in the two-dimensional wavenumber-frequency spectra at the zeroth spanwise wavenumber, acoustic peaks associated with both longitudinal and oblique propagating waves are clearly identifiable, although they are several orders of magnitude weaker than the convective peak. The number of oblique-wave peaks at each frequency matches the theoretical prediction for duct acoustic modes. The effect of a small two-dimensional hump on the channel surface is also investigated. The results suggest that acoustic scattering by the hump vastly increases the acoustic energy for both longitudinal and oblique modes.

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