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Acoustic Radiation from High-Speed Turbulent Boundary Layers[1] LIAN DUAN, Missouri University of Science and Technology, MEELAN CHOUDHARI, NASA Langley Research Center — Direct numerical simulations (DNS) are used to examine the pressure fluctuations generated by a high-speed turbulent boundary layer with nominal freestream Mach number of 6 and Karman number of $Re_\tau \approx 464$. The emphasis is on comparing the primarily vortical pressure signal at the wall with the acoustic freestream signal under higher Mach number conditions. Moreover, the Mach-number dependence of pressure signals is investigated by comparing the current results with those of a supersonic boundary layer at Mach 2.5 and $Re_\tau \approx 510$. It is found that the freestream pressure intensity exhibits a strong Mach number dependence, irrespective of whether it is normalized by the mean wall shear stress or by the mean pressure. Spectral analysis shows that both the wall and freestream pressure fluctuations of the Mach 6 boundary layer have enhanced energy content at high frequencies. The computed Mach-number dependence of the acoustic field, including radiation intensity, directionality, and convection speed, is consistent with trends in measurements. The numerical database is used to understand the acoustic source mechanisms for both adiabatic and cold wall configurations.

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