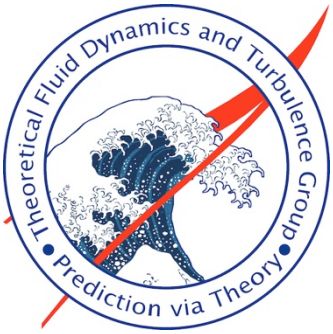
Nonnormality of Sonic Boom Loudness Metrics in the Turbulent Atmospheric Boundary Layer at Large Lateral Distances from the Flight Path



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Atmospheric boundary layer (ABL) turbulence causes variability of the sonic boom waveform at the ground. Recent numerical investigations of sonic boom propagation through kinematic velocity fluctuations indicate that loudness metric distributions are positively skewed relative to a normal distribution. This skewness depends on the propagation distance and turbulence intensity. Propagation simulations of N-waves and shaped booms through inhomogeneous ABL turbulence are presented. Meteorological conditions are varied to examine different daytime ABL conditions and their effect on sonic boom loudness distributions. Two outcomes are observed: 1) the loudness metric distributions become increasingly positively skewed as the propagation distance through the ABL increases, and 2) the distributions become increasingly positively skewed at the same lateral distance from the flight path as the convection level of the daytime ABL is increased. Thus, results indicate that ground level measurements of sonic boom loudness from flight tests performed at large lateral distances from the flight path may not be normally distributed, due to turbulence present in the ABL. (This research is supported by the Commercial Supersonic Technology Project of the National Aeronautics and Space Administration under Grant No. 80NSSC19K1685.)