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Very-Large-Scale Coherent Structures in the Wall Pressure Field Beneath a Supersonic Turbulent Boundary Layer STEVEN BERESH, JOHN HENFLING, RUSSELL SPILLERS, BRIAN PRUETT, Sandia National Laboratories — Previous wind tunnel experiments up to Mach 3 have provided fluctuating wall-pressure spectra beneath a supersonic turbulent boundary layer, which essentially are flat at low frequency and do not exhibit the theorized ω^2 dependence. The flat portion of the spectrum extends over two orders of magnitude and represents structures reaching at least 100 δ in scale, raising questions about their physical origin. The spatial coherence required over these long lengths may arise from very-large-scale structures that have been detected in turbulent boundary layers due to groupings of hairpin vortices. To address this hypothesis, data have been acquired from a dense spanwise array of fluctuating wall pressure sensors, then invoking Taylor's Hypothesis and low-pass filtering the data allows the temporal signals to be converted into a spatial map of the wall pressure field. This reveals streaks of instantaneously correlated pressure fluctuations elongated in the streamwise direction and exhibiting spanwise alternation of positive and negative events that meander somewhat in tandem. As the low-pass filter cutoff is lowered, the fluctuating pressure magnitude of the coherent structures diminishes while their length increases.

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