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Effects of upstream boundary layer on the unsteadiness of shock induced separation BHARATHRAM GANAPATHISUBRAMANI, NOEL CLEMENS, DAVID DOLLING, Center for Aeromechanics Research, The University of Texas at Austin — The relationship between the upstream boundary layer and the unsteadiness of the separated flow in a Mach 2 compression ramp interaction is investigated by performing wide-field PIV and PLS measurements in streamwise-spanwise planes. Measurements in the upstream boundary layer indicate the presence of spanwise strips of elongated regions of uniform momentum with lengths greater than 40δ. These long coherent structures have been observed in a Mach 2 supersonic boundary layer and they exhibit strong similarities to those that have been found in incompressible boundary layers. At a wall-normal location of $y/\delta = 0.2$, the upstream envelope of the separation region is found to oscillate between x/δ = -3 and -1 (where $x/\delta = 0$ is the ramp corner). The instantaneous spanwise separation line is found to respond to the elongated regions of uniform momentum. It is shown that high- and low-momentum regions are correlated with smaller and larger scale for the separation region, respectively. Furthermore, the instantaneous separation line exhibits large-scale undulations that conform to the low- and high-speed regions in the upstream boundary layer. The low frequency unsteadiness of the separation region/shock foot observed in numerous previous studies can be explained by a turbulent mechanism that includes elongated regions of uniform momentum.

Bharathram Ganapathisubramani
Center for Aeromechanics Research, The University of Texas at Austin

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