Unsteadiness of shock wave boundary layer interaction

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Interaction between shock wave and boundary layer can cause boundary layer separation. Turbulent boundary layer separation is non-stationary phenomenon [1]. Influence of wall temperature condition on the separation region unsteadiness was investigated. Separation of turbulent boundary layer was studied in supersonic flow on the compression ramp with angles of 23° and 30°. Wall temperature condition was described by temperature ratio $T_w/T_\infty$ and was altered in range of 1.6–3.11. During the experiments averaged velocity and root-mean-square (RMS) velocity fields of separation region were obtained by means of Particle Image Velocimetry. Averaged velocity fields was used to measure reattached boundary layer thickness and velocity profile. For adiabatic wall reattached boundary layer has thickness about 4.2 mm and 6 mm for 23° and 30° ramp, respectively. For heated wall condition boundary layer thickness increases in both cases. Comparative analysis of separation on 23° and 30° ramp has shown that for equal separation length reattached boundary layer thickness has almost the same value. RMS velocity fields have shown regions of velocity perturbation. According to the experiments most perturbed area is at the separation position. Reattachment region also has strong perturbation. These regions of velocity perturbation are related to the separation boundaries oscillation. For both 23° and 30° ramp Increasing temperature ratio causes prolongation of perturbed regions. Length of these regions mainly depends on temperature ratio and and weakly depends on separation length.