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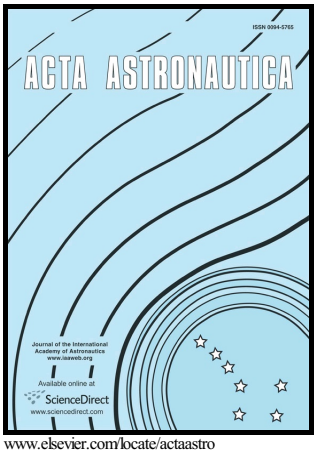

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Abstract

Near space has been paid more and more attentions in recent years due to its militarily application value. Direct simulation Monte Carlo (DSMC) which is one of the most successful particle simulation methods in treating rarefied gas dynamics is employed to investigate the flow characteristics of a hypersonic backward-facing step (BFS) under active flow control using supersonic jet in near space. The numerical tool is validated by an experimental flow of dual cusped-plate model, shock wave structures from the numerical simulation are shown in quite good agreement with the experimental result. The influence of altitude and active flow control on BFS flow are then studied in detail. Three parameters, i.e. boundary layer thickness, recirculation region length, and lean angle of the primary recirculation region that is first defined to describe recirculation region shape, are used to evaluate the flow characteristics of every case computed. The numerical results indicate that the main effect of vertical jet upstream of the step is the enhancement of boundary layer thickness downstream of the jet slot, then, it shows a weak influence on recirculation region length and a negligible effect on lean angle. Conversely, the horizontal jet near the step edge can greatly change the recirculation region length by adjusting jetting angle, but it only has a weak influence both on boundary layer thickness and on lean angle for every jetting angle considered. A significant finding is that the recirculation region length is