COMPUTATIONAL STUDIES OF LAMINAR-TURBULENT TRANSITION ON A SHARP CONE WITH LOCAL HEATING OR COOLING

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The localized heating and cooling effects on stability of the boundary layer on a sharp cone of 7-deg half angle were analyzed at the free-stream Mach number 6 and zero angle of attack. Three different positions of the heating/cooling strip were considered. The steady-state laminar flow was calculated using Navier – Stokes equations. These solutions were used as a mean flow for the spatial stability analyses providing the growth rates and amplification N-factors of the Mack second mode. In the framework of e^N method, heating or cooling element may cause earlier or later transition depending on the choice of critical N-factor. There is a concept that in the relaxation region developed downstream of the heating strip, the boundary layer temperature is larger than the wall temperature so that the boundary layer “sees” a relatively cold wall. According to the linear stability theory this leads to increasing of the second mode growth rates. Our results are not consistent with this concept. The discrepancy may be due to additional effects associated with pressure gradient, local Mach number and other factors.

Key words: boundary layer stability, transition, local heating and cooling