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无隔道超声速进气道/前机身一体化计算与试验

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Numerical Simulation and Experiment of Integral Flow Fieldof Diverterless Supersonic Inlet/Forebody

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摘要 针对某飞机设计了机身两侧进气的无隔道超声速进气道（Bump进气道），进行了进气道/前机身一体化的三维内外流流场数值模拟研究，得到了进气道的流场图谱，比较了唇口方案对附面层排移效果的影响，并对比分析了带隔道的斜板式进气道与无隔道进气道的流场特征及附面层排除特点的差异。根据设计和计算结果，进行了斜板式及Bump进气道模型的风洞试验，通过试验对比，选择了较优的Bump进气道方案，并将不同模型比例和风洞、高空条件下的计算结果与试验数据进行了比较，发现在计算条件、模型比例都与风洞吹风条件一致的情况下，数值模拟的结果与试验数据吻合最好。研究结果表明，Bump进气道气动性能优于斜板式进气道，采用“双斜切”唇口方案设计的Bump进气道能进一步增加排除附面层的效果，按高空条件计算得到的进气道总压恢复系数比按地面风洞条件计算值高0.02～0.03。

关键词： 无隔道超声速进气道 Bump进气道 进气道设计 超声速流 一体化设计 计算流体力学 风洞

Abstract： A side-mounted diverterless supersonic inlet (Bump inlet) is designed and the external and internal flow fields of the integral inlet/forebody are calculated. The Mach number contours and the pressure distribution of the flow fields are presented. Two lips with different inclination angles are designed and their effect on bypassing the boundary layer is compared. Furthermore, the flow characteristics between the Bump inlet and the ramp inlet with diverter are presented. Wind tunnel tests of the ramp inlet and Bump inlet models are conducted. The computational results with different model scales and inflow conditions (wind tunnel/flight conditions) are compared with experimental data, which showed good agreement. It can be concluded that the Bump inlet has better aerodynamic performance than the ramp inlet, and that the lip with two inclination angles can enhance the effect of bypassing the boundary layer. It is also discovered that the total pressure recovery of inlet calculated by flight condition is higher than that calculated by wind tunnel condition by 0.02-0.03.

Keywords： diverterless supersonic inlet Bump inlet inlet design supersonic flow integrated design computational fluid dynamics wind tunnel

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