李永洲,张堃元,罗蕾,王磊.高超声速内收缩进气道轴对称基准流场改进[J].航空动力学报,2013,28(11):2543~2552

高超声速内收缩进气道轴对称基准流场改进

Modified axisymmetric basic flowfield for hypersonic inward turning inlet

投稿时间： 2012-10-31

DOI：

中文关键词： 高超声速 内收缩进气道 基准流场 马赫数分布 设计方法 数值仿真

英文关键词:hypersonic inward turning inlet basic flowfield Mach number distribution design method numerical simulation

基金项目:国家自然科学基金(90916029,91116001)

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中文摘要：

针对轴对称基准流场中前缘曲激波靠近中心体的部分激波强度过大现象,基于马赫数分布可控反设计方法,将这道前缘曲激波分解为一道较弱弯曲激波和部分等熵压缩波,改进的基准流场存在“四波四区”结构且压缩效率明显提高.基于该改进的基准流场和常规“两波三区”基准流场分别设计了圆形进口的内收缩进气道并对其流场特点和性能进行数值研究.结果表明:改进的进气道的流场能较好保持基准流场的特点;在来流马赫数为4.0~7.0范围内具有较高的压缩效率和良好的流量捕获能力,设计点的出口压比和总压恢复系数分别为17.56和0.540;改进的进气道采用来流马赫数从高到低前缘弯曲激波和汇集的等熵压缩波依次封口的设计概念,在提高流量捕获能力的同时减小了总压损失,总体性能优于常规进气道,来流马赫数为7.0时总压恢复系数相对提高了23.6%,来流马赫数为4.0时流量系数相对提高了5.7%.

英文摘要：

The leading edge shock wave near the center body,which is too intensive in axisymmetric basic flowfield,was separated into one curved shock and partial isentropic compression wave using the design method of controllable Mach number distribution.With a structure of four shock waves and four regions,the modified basic flowfield could improve compression efficiency obviously.The circular intake inward turning inlets for modified basic flowfield and common basic flowfield of two shock waves and three regions were designed,and also numerically studied to obtain the flowfield characteristics and general performance.The results indicate the modified inlet has similar flowfield characteristics for the basic flowfield.It features high compression ratio and mass flow capture capability for Mach number of 4.0 to 7.0,and the pressure ratio and total pressure recovery coefficient are 17.56 and 0.540,respectively,at the design point.Besides,the leading shock and converged isentropic compression wave attached the cowl lip in turn while the Mach number of incoming flow varied from high to low,increasing the mass capture ratio and decreasing the total pressure loss.Its overall performance is better than common one with 23.6% higher total pressure recovery coefficient at Mach number of 7.0 and 5.7% higher mass flow coefficient at Mach number of 4.0.