李永洲,张堃元,朱伟,杨顺凯.双弯曲入射激波的可控中心体内收缩基准流场设计[J].航空动力学报,2015,30(3):563~570

双弯曲入射激波的可控中心体内收缩基准流场设计

Design for inward turning basic flowfield with controlled center body and two incident curved shock waves

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中文关键词: 高超声速进气道 基准流场 弯曲激波 中心体 反设计

英文关键词:hypersonic inlet basic flowfield curved shock wave center body inverse design

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中文摘要:

采用有旋特征线法设计了一种双弯曲入射激波的可控中心体内收缩基准流场,两道入射激波交于中心体起始点,入射激波和反射激波通过给定激波径向总压恢复系数分布进行反设计,壁面通过给定轴向马赫数分布规律进行反设计.该基准流场分为“三波四区”且压缩效率较高.基于该基准流场设计了圆形进口内收缩进气道并进行了黏性修正,数值计算结果表明:内收缩进气道设计点核心区的流场特征和激波形状与基准流场基本一致;在来流马赫数为4.0~7.0时进气道具有较高的压缩效率和良好的流量捕获能力,设计点喉道截面增压比和总压恢复系数分别为17.7和0.729;来流马赫数为5.0~7.0时内部总阻力系数变化平缓,从0.23下降为0.22.

英文摘要:

A basic flowfield with controlled center body and two incident curved shock waves was designed by rotational method of characteristics. The two incident shock waves were intersected at the initial point of the center body. Both incident shock waves and reflected shock waves were inversely designed by the given radial total pressure recovery coefficient distribution,and the wall was inversely designed by the given axial Mach number distribution. The basic flowfield with high compression efficiency was divided into three shock waves and four regions. On the basis of the basic flowfield,the inward turning inlet with circle shape intake was designed and corrected by viscosity. The computational results indicate that the flowfield characteristics and the shock waves of the core of inward turning inlet are consistent with those of the basic flowfield at design point. The inlet has good compression efficiency and mass capture ratio with incoming Mach number varying from 4.0 to 7.0. At design point, the pressure ratio of the throat is 17.7 and the total pressure recovery coefficient is 0.729. The internal total drag coefficient decreases from 0.23 to 0.22 with incoming Mach number varying from 5.0 to 7.0.

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