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矩形转圆形高超声速内收缩进气道数值及试验研究

南向军[1], 张堃元[1], 金志光[1], 孙波[2]

1. 南京航空航天大学 能源与动力学院, 江苏 南京 210016;
2. 南京理工大学机械工程学院, 江苏 南京 210094

Numerical and Experimental Investigation of Hypersonic Inward Turning Inlets with Rectangular to Circular Shape Transition

NAN Xiangjun[1], ZHANG Kunyuan[1], JIN Zhiguang[1], SUN Bo[2]

1. College of Energy & Power Engineering, Nanjing University of Aeronautics and Astronautics, Nanjing 210016, China;
2. School of Mechanical Engineering, Nanjing University of Science and Technology, Nanjing 210094, China

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摘要 采用压力梯度先增大后减小压升规律轴对称基准流场,结合流线追踪及截面渐变技术设计了矩形转圆形内收缩进气道模型,并采用4°斜楔模拟飞行器前体,对前体、进气道一体化模型进行了数值模拟和风洞试验,初步得到了该进气道的流场结构及总体性能。设计点和接力点的数值模拟结果表明该进气道可在马赫数*Ma*=4~6状态下正常工作,且具有良好的总体性能。在设计点*Ma*=6、正4°攻角状态进行的风洞试验表明,该进气道增压比为41.2,总压恢复达0.45,至少可抵抗200倍来流静压的反压。

关键词： 高超声速进气道 基准流场 压升规律 数值模拟 风洞试验

Abstract: With pressure gradient on the wall of the inlet's basic flow field increasing at the front part then decreasing at the rear part, using streamline tracing and varying section techologies, a hypersonic inward turning inlet with rectangular to circular shape transition integrated into 4° wedge forebody, is designed and investigated with numerical simulation and experimental method. The flow field structure and performance of the inlet are primarily obtained. The simulation results of design points and take-over speeds indicate that this inlet can operate normally over the Mach number range of 4-6 and has good performance with 4° angle of attack. The inlet model is tested in a hypersonic wind tunnel at Mach number 6 with 4° angle of attack. And the experimental results indicate that the scaled inlet model's total pressure recovery is 0.45. It can generate a compression ratio of 41.2 and withstand a back pressure ratio of 200 relative to tunnel static pressure.

Keywords: hypersonic inlets basic flowfield law of pressure rise numerical analysis wind tunnel test

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Corresponding Authors: Tel.: 025-84892201-2100 E-mail: zkype@nuaa.edu.cn Email: zkype@nuaa.edu.cn

About author: 南向军(1985-) 男,博士研究生。主要研究方向:内流气体动力学。 E-mail: nanxj12@163.com张堃元(1943-) 男,硕士,教授,博士生导师。主要研究方向:内流气体动力学。 Tel: 025-84892201-2100 E-mail: zkype@nuaa.edu.cn 金志光(1977-) 男,博士,副教授,硕士生导师。主要研究方向:内流气体动力学。 E-mail: j_zg77@yahoo.com.cn孙波(1980-) 男,博士,讲师,硕士生导师。主要研究方向:内流气体动力学。 E-mail: hypersun@mail.njust.edu.cn

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