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多点集中力下高超进气道弹性变几何研究

Research on elastic deformable geometry of hypersonic inlet with multiple forces

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中文摘要:

针对二元高超声速进气道需在宽马赫数*Ma*为4.5~6.0的范围内工作的要求,探索了一种在多点集中力作用下进气道曲面压缩面弹性可调的变几何方案.通过数值计算,首先对集中力数目的选取进行了研究,发现3个集中力对型面变形更为有效;然后对在3个集中力作用下产生变形的进气道进行了流固耦合分析,结果表明变形型面的静压分布与理想型面的静压分布基本吻合;对其性能进行分析,结果表明:*Ma*为6.0设计的进气道,变形后在*Ma*为4.5,5.0流量系数分别达到0.98和1.00,且出口总压恢复系数与未变形的进气道相比基本保持不变.由此说明,多点集中力下弹性可调的变几何方案是可行的,并有助于提高非设计点下进气道的性能.

英文摘要:

Since 2-D hypersonic inlet should work with Mach numer ranging from 4.5 to 6.0, an elastically deformable scheme of inlet's compression surface with multiple forces was explored in this work. With numerical computation, the optimal number of forces was firstly studied. The results showed that three forces were more effective in elastic deformation. Then the inlet deformation with the three forces was analyzed by the method of fluid-structure interaction (FSI). The results indicated that the distribution of static pressure on the deformable compression surface was almost consistent with that on the ideal surface. The results of performance analysis demonstrated that the flow coefficient of the 2-D inlet designed at Mach numer is 6.0 could reach 0.98 at Mach numer is 4.5 and 1.00 at Mach numer is 5.0 after deformation. Furthermore, the total pressure at exit section just remained unchanged compared with fixed geometry inlet. These indicate that the elastically deformable scheme of 2-D inlet with multiple forces is feasible, and also helpful to improve the inlet's characteristics at off-design points.

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