[1]吴朋朋,杨月诚,高双武,等.大面积比喷管侧向载荷流固耦合数值仿真[J].弹箭与制导学报,2013,02:75-78.

WU Pengpeng,YANG Yuecheng,GAO Shuangwu,et al.Fluid-solid Coupling Numerical Simulation of Side Load in SRM Nozzle [J].,2013,02:75-78.

大面积比喷管侧向载荷流固耦合数值仿真(PDF)

《弹箭与制导学报》[ISSN:1673-9728/CN:61-1234/TJ] 期数: 2013年02期 页码: 75-78 栏目: 火箭技术 出版日期: 2013-04-25

Title: Fluid-solid Coupling Numerical Simulation of Side Load in SRM Nozzle

作者: 吴朋朋; 杨月诚; 高双武; 赵奇国

第二炮兵工程大学,西安 710025

Author(s): WU Pengpeng; YANG Yuecheng; GAO Shuangwu; ZHAO Qiguo

The Second Artillery Engineering University, Xi'an 710025, China

关键词: 固体火箭发动机; 大面积比喷管; 侧向载荷; 流固耦合

Keywords: solid rocket motor; over-expanded nozzle; side load; fluid-solid coupling

分类号: V435

DOI: -

文献标识码: A

摘要: 针对大面积比喷管在地面试车以及启动与关机过程中出现的侧向载荷,采用三维数值仿真方法进行分析。通过集成软件平台MpCCI,连接计算流体动力学软件FLUENT和有限元软件ABAQUS,对燃气流动与喷管结构运动变形进行了耦合计算。计算分析了喷管入口总压从3MPa增大到7MPa共五种条件下,各个阶段的侧向载荷及喷管结构参数随时间变化情况,分析发现此喷管将受到一定的侧向载荷作用,载荷方向随机分布。入口总压为4MPa时的侧向载荷峰值最大。分析也得出了这五种条件下较强的侧向载荷主要由激波转变和喷管出口部位的激波振荡两种不对称状态产生;侧向载荷的大小也与喷管入口总压有较大关系。采用流固耦合计算方法能体现喷管的结构变形从而更准确的反映喷管与燃气流相互影响的真实环境,为优化设计大面积比喷管提供了支撑。

Abstract: A side load in the over-expanded nozzle was studied by means of a three-dimensional numerical simulation method. The MpCCI software was used to link the FLUENT CFD code whose UDF was applied to the ABAQUS FE code to analyze gas flow and nozzle deformation.The structure parameters and the side load under work conditions from 3MPa inlet total pressure to 7MPa inlet total pressure were obtained. Through calculation, the biggest side load under 4MPa inlet total pressure was obtained. The result analysis show that two types of asymmetric shock physics incur strong side loads: the shock transitions, and shock pulsations across the nozzle lip. Moreover, the results show that the inlet total pressure has potential effect on the nozzle side loads. The fluid-solid coupling numerical simulation supports the accuracy of the method of numerical simulation. The simulation provides the base for further study.

导航/NAVIGATE

本期目录/Table of Contents

下一篇/Next Article

上一篇/Previous Article

工具/TOOLS

引用本文的文章/References

下载 PDF/Download PDF(1014KB)

立即打印本文/Print Now

参考文献/REFERENCES

[1] Wang T-S. Transient three-dimensional startup side load analysis of a regenerative cooled nozzle, AIAA 2008-4300[R].

2008.
[2] Wang T-S, Mike Guidos. Transient three-dimensional side load analysis of a film cooled nozzle, AIAA 2008-4297[R]. 2008.
[3] S J Zhang,T Fuchiwaki.Aeroelastic coupling and side loads in rocket nozzles, AIAA 2008-4064[R].2008.
[4] Frey M,Hagemann G.Status of flow separation prediction in rocket nozzles [C]//34th AIAA/ASME /SAE /ASEE Joint Propulsion Conference Exhibit,1998.

备注/Memo: 收稿日期:2012-06-28 作者简介:吴朋朋(1982-),男,安徽宿州人,硕士研究生,研究方向:航空宇航推进理论与工程。

更新日期/Last Update: 2013-04-25