



航空学报 » 2006, Vol. 27 » Issue (5) : 778-783 DOI:

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战斗机弹射救生系统数值模拟研究

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Numerical Simulation Research of the Fighter Ejection Escape System

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摘要

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摘要 对弹射救生系统这种几何外形复杂、不规则非流线型钝体,以Jameson有限体积法为基础发展了一套基于高质量混合网格的Euler方程解算器,在Euler方程解算器基础上,采用S-A湍流模型发展了一套同样基于混合网格的N-S方程解算器,初步建立了适合弹射救生系统这类几何外形复杂物体的数值模拟技术平台,并采用多种加速收敛措施和合适的耗散项模型使得所发展的解算器在软件实现上鲁棒性很强。通过选取合适的计算起始迎角,对弹射救生系统成功地进行了大迎角和大侧滑角绕流计算,获得了与风洞试验比较吻合的计算结果,并且可以清楚地观察流场中马赫数分布、弹射救生系统各部位压力分布等流场细节,对弹射救生系统空气动力特性分析具有重要的指导意义。该计算平台可作为风洞试验的合理补充、加强和完善。

关键词: 航空工程 弹射救生系统 数值模拟 混合网格 Navier-Stokes方程

Abstract: Based on Jameson's finite volume method, an Euler equation solver with high precision hybrid grid is developed to calculate the aerodynamic characteristics of ejection escape system with complex, non-regular and non-streamline shape. An N-S equation solver with S-A turbulence model based on Euler equation solver is also developed in the paper. Several speeding convergence measures make the solution more reliable. The computation result for ejection seat system at large angle of attack is in good accordance with the wind tunnel test result. It can help to analyze the aerodynamic characteristics of ejection seat system by Mach number distribution, pressure distribution and so on. The numerical simulation can be the reasonable complement of wind tunnel test.

Keywords: aerospace engineering ejection escape system numerical simulation hybrid grid Navier-Stokes equation

Received 2005-04-01; published 2006-10-25

引用本文:

陈德华; 吴文华; 王晋军. 战斗机弹射救生系统数值模拟研究[J]. 航空学报, 2006, 27(5): 778-783.

CHEN De-hua; WU Wen-hua; WANG Jin-jun. Numerical Simulation Research of the Fighter Ejection Escape System[J]. Acta Aeronautica et Astronautica Sinica, 2006, 27(5): 778-783.

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