航空学报
ACTA AERONAUTICA ET ASTRONAUTICA SINICA
ISSN 1000-6893
CN 11-1929/V

航空学报 » 2013, Vol. 34 » Issue (2) :235-245 DOI: 10.7527/S1000-6893.2013.0027

改进型CLOR桨尖旋翼气动特性试验研究及数值分析

王博, 招启军, 赵国庆, 徐国华

南京航空航天大学 直升机旋翼动力学国家级重点实验室, 江苏 南京 210016

Experimental Research and Numerical Analysis on Aerodynamic Characteristics of Rotors with Improved CLOR Blade-tip

WANG Bo, ZHAO Qijun, ZHAO Guoqing, XU Guohua

National Key Laboratory of Science and Technology on Rotorcraft Aeromechanics, Nanjing University of Aeronautics and Astronautics, Nanjing 210016, China

摘要 | 参考文献 | 相关文章

Download: PDF (4407KB) HTML 0KB Export: BibTeX or EndNote (RIS) Supporting Info

摘要

通过风洞试验及数值模拟对具有改进型CLOR(CLOR-Ⅱ)桨尖的旋翼悬停和前飞状态气动特性开展研究。在CLOR桨尖旋翼试验及数值分析的基础上,考虑旋翼非定常流场特点,兼顾旋翼悬停和前飞气动性能,对旋翼桨叶的气动外形进行了改进,主要包括采用多种翼型优化配置以综合改善旋翼前行侧压缩性及后行侧桨叶失速特性,并考虑旋翼前飞状态对其桨叶动力学特性的需求,重新设计了桨尖前后缘的外形。在风洞中分别对3种旋翼进行多种状态条件下的试验研究,为从流动细节上获得不同桨尖旋翼的气动特性差别,采用计算流体力学(CFD)方法对试验状态进行了数值模拟对比。对更高转速状态进行模拟,结果表明相对于其他两种旋翼,CLOR-Ⅱ桨尖旋翼在改善跨声速特性和提高失速迎角等方面具有明显优势,而且综合提高了旋翼悬停和前飞气动性能。

关键词: 气动特性 旋翼 试验 新型桨尖 直升机 计算流体力学

Abstract:

Wind tunnel test and numerical simulation are performed to investigate the aerodynamic characteristics of rotors with an improved CLOR (CLOR-Ⅱ)blade-tip in hover and forward flight. Taking into consideration the unsteady characteristics of the rotor flowfield, and aiming at advanced aerodynamic performance of the rotors in both hover and forward flight, the aerodynamic shape of the rotor blade is redesigned using aerodynamic analysis based on the investigations of rotors with CLOR tip. It mainly includes the optimal allocation of airfoils on the spanwise direction of the rotor blade for improving such properties as advancing blade compressibility and retreating blade dynamic stall, and the shape of the blade tip is designed meticulously taking into account the dynamic characteristics of the blade in forward flight. The three types of rotors are measured in a wind tunnel under multi-conditions. Based on these, the aerodynamic characteristics of rotors under the same conditions with the tests are simulated by computational fluid dynamics (CFD) and the calculated results are compared with the experimental results. Additionally, higher speed rotation conditions are also computed. Results show that the obvious advantages of the rotors with CLOR-Ⅱ tip in suppressing the transonic strength and increasing the stall angle of attack are demonstrated by comparing with the other two types of rotors, and the characteristics of the rotors in hover and forward flight are comprehensive improved.

Keywords: aerodynamic characteristics rotors experiments new type blade-tip helicopters computational fluid dynamics

Received 2012-02-29; published 2012-08-01

Fund:

国家自然科学基金(10872094)

Corresponding Authors: 招启军 Email: zhaoqijun@nuaa.edu.cn

Service

把本文推荐给朋友

加入我的书架

加入引用管理器

Email Alert

RSS

作者相关文章

王博

招启军

赵国庆

徐国华

About author: 王博,男,博士研究生。主要研究方向:直升机旋翼CFD、直升机空气动力学和气动声学。Tel:025-84892117,E-mail:wangbo@nuaa.edu.cn;招启军,男,博士,教授,博士生导师。主要研究方向:直升机旋翼CFD、直升机空气动力学和气动声学。Tel:025-84893753,E-mail:zhaoqijun@nuaa.edu.cn;赵国庆,男,博士研究生。主要研究方向:直升机旋翼CFD、直升机空气动力学。Tel:025-84893753,E-mail:zgq198495@nuaa.edu.cn;徐国华,男,博士,教授,博士生导师。主要研究方向:直升机空气动力学、直升机旋翼CFD和气动声学。Tel:025-84892117,E-mail:ghxu@nuaa.edu.cn

引用本文:

王博, 招启军, 赵国庆, 徐国华. 改进型CLOR桨尖旋翼气动特性试验研究及数值分析[J]. 航空学报, 2013, 34(2): 235-245.DOI: 10.7527/S1000-6893.2013.0027

WANG Bo, ZHAO Qijun, ZHAO Guoqing, XU Guohua. Experimental Research and Numerical Analysis on Aerodynamic Characteristics of Rotors with Improved CLOR Blade-tip[J]. Acta Aeronautica et Astronautica Sinica, 2013, 34(2): 235-245.DOI: 10.7527/S1000-6893.2013.0027