蒋相闻,招启军.考虑旋翼调制影响的直升机RCS特性分析及评估[J].航空动力学报,2014,29(4):824~834

考虑旋翼调制影响的直升机RCS特性分析及评估

Analysis and evaluation on RCS characteristics of helicopter considering modulated effect of rotor

投稿时间： 2013-01-18

DOI：10.13224/j.cnki.jasp.2014.04.012

中文关键词： 直升机 旋翼 雷达散射截面 调制 综合分析 物理光学法 等效电磁流法

英文关键词:helicopter rotor radar cross section modulation comprehensive analysis physical optics method of equivalent currents

基金项目:

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中文摘要:

考虑旋翼调制的影响，建立了适合于直升机全机雷达散射截面（RCS）特性计算的“面元-边缘法”.兼顾计算效率和精度，在外形变化剧烈地区域，网格进行加密处理，并保证电磁网格密度和尺度满足雷达波波长大小的比例关系.以桨盘倾倒方式计入桨叶的挥舞和变距运动，采用准静态法模拟旋翼对全机RCS特性的影响.分析了某直升机RCS极化、姿态、频率响应特性，并根据直升机RCS和雷达探测距离关系，提出了4级预警机制和角域范围.研究表明：旋翼转动时全机RCS动态响应具有连续性和对称性，振荡区散射水平强，RCS幅值为-5~12dB ·m^2；奇数片桨叶比偶数片桨叶的RCS减缩2~5dB ·m^2，且有利于控制直升机RCS包络线和散射峰值的时域响应，增强雷达隐身性能.

英文摘要:

Considering the modulated effect of rotor, a panel-edge method suitable for solving radar cross section (RCS) characteristics of the whole helicopter was developed. In order to improve grid generating quality of large shape changes, the high density grids were generated considering the accuracy and efficiency. Simultaneously, the density and scale of electromagnetic grids need to meet the radar wave length ratio. The blade pitching and flapping motions were included by inclination of disk, and the RCS characteristics of the whole helicopter effected by rotor were simulated by the quasi-static method. Then calculations and simulations on RCS of an helicopter about the polarization, attitude and frequency responses were carried out. According to the relationship between RCS of helicopter and detecting distance of radar, four-stage warning mechanism and angle domains were presented. The results show that the RCS dynamic responses of the whole helicopter is continuous and symmetric considering the rotating rotor, and the oscillation scattering is strong, with the amplitude of RCS between -5 to 12dB ·m^2. Compared with even blades, the RCS of odd blades is reduced from 2 to 5dB ·m^2, and the RCS envelope and time domain responses of scattering peak are controlled. Finally, the radar stealth performance can be improved.