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反流区对复合高速直升机旋翼气动特性的影响

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Effect of Reverse Flow Region on Characteristics of Compound High Speed Helicopter Rotor

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摘要

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摘要 针对复合式直升机高前进比旋翼反流区严重的特点,建立了适合于高前进比旋翼气动特性的分析方法,以H-34旋翼为例计算了该旋翼在高前进比状态下的气动性能,并与已有的风洞试验数据进行对比验证。在此基础上,进一步分析了反流区对高前进比旋翼气动性能以及对桨叶剖面迎角、升力系数和阻力系数的影响。结果表明:反流区越大,对旋翼的气动性能影响越显著;桨叶剖面迎角在反流区边界发生突变,反流区内外的桨叶剖面迎角、升力系数和阻力系数存在明显差别。

关键词: 直升机 高前进比旋翼 反流区 气动特性 挥舞运动 诱导速度

Abstract: A method to predict the aerodynamic characteristics of a rotor at high advanced ratio is proposed which takes into consideration the particularity of the compound high speed helicopter rotor with a severe reverse flow region. The method is then used to calculate the aerodynamic performance of an H-34 rotor with various combinations of advanced ratios and rotor angles of attack and the results are compared with wind tunnel test data. The article further analyzes the effect of reverse flow region on the performance of the H-34 rotor at various high advanced rotor ratios as well as on the angle of attack, the lift and drag coefficients of the blade sections. The results show that the larger the area of the reverse flow region, the greater is its influence on the rotor performance and angle of attack, lift and drag coefficients of the blade sections. Furthermore, the angle of attack of a blade section exhibits rapid change on the boundary of the reverse flow region. There are obvious differences between the angle of attack, the lift and drag coefficients of the blade sections inside and outside the reverse flow region.

Keywords: helicopter high advanced ratio rotor reverse flow region aerodynamic characteristic flapping motion induced velocity

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